UNIVERSITY OF ALBERTA

MEMORY STRATEGY ASSESSMENT WITH ADOLESCENTS WITH MILD MENTAL DISABILITIES

BY

AVA KI-WA TIN KWONG

A thesis submitted to the Faculty of Graduate Studies and Research in partial fulfilment of the requirements for the degree of DOCTOR OF PHILOSOPHY.

IN

SPECIAL EDUCATION

DEPARTMENT OF EDUCATIONAL PSYCHOLOGY

EDMONTON, ALBERTA

SPRING 1994

National Library of Canada
Acquisitions and Bibliographic Services
395 Wellington Street
Ottawa ON K1A 0N4
Canada

Bibliothèque nationale du Canada
Acquisitions et services bibliographiques
395, rue Wellington
Ottawa ON K1A 0N4
Canada

Your file Votre référence

Our file Notre référence

The author has granted a non-exclusive licence allowing the National Library of Canada to reproduce, loan, distribute or sell copies of this thesis in microform, paper or electronic formats.

L'auteur a accordé une licence non exclusive permettant à la Bibliothèque nationale du Canada de reproduire, prêter, distribuer ou vendre des copies de cette thèse sous la forme de microfiche/film, de reproduction sur papier ou sur format électronique.

The author retains ownership of the copyright in this thesis. Neither the thesis nor substantial extracts from it may be printed or otherwise reproduced without the author's permission.

L'auteur conserve la propriété du droit d'auteur qui protège cette thèse. Ni la thèse ni des extraits substantiels de celle-ci ne doivent être imprimés ou autrement reproduits sans son autorisation.

0-612-22152-0

Canada

UNIVERSITY OF ALBERTA

RELEASE FORM

NAME OF AUTHOR: Ava Ki-wa Tin Kwong

TITLE OF THESIS: Memory Strategy Assessment with Adolescents with Mild Mental Disabilities

DEGREE: Doctor of Philosophy

YEAR THIS DEGREE GRANTED: Spring, 1994

Permission is hereby granted to the University of Alberta Library to reproduce single copies of this thesis and to lend or sell such copies for private, scholarly or scientific research purposes only.

The author reserves all other publication and other rights in association with the copyright in the thesis, and except as hereinbefore provided neither the thesis nor any substantial portion thereof may be printed or otherwise reproduced in any material form whatever without the author's prior written permission.

(Signed) A Kwong

PERMANENT ADDRESS:
250 Ormsby Road
East, Edmonton,
Alberta

DATE: October 25, 1993

UNIVERSITY OF ALBERTA

FACULTY OF GRADUATE STUDIES AND RESEARCH

The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research for acceptance, a thesis entitled MEMORY STRATEGY ASSESSMENT WITH ADOLESCENTS WITH MILD MENTAL DISABILITIES submitted by Ava Ki-wa Tin Kwong in partial fulfillment of the requirements for the degree of Doctor of Philosophy in Special Education.

.....
Dr. R. F. Mulcahy

.....
Dr. R. H. Short

.....
Dr. F. D. Snart

.....
Dr. L. R. Wilgosh

.....
Dr. G. Mallicky

DATE October 21, 1993

Abstract

The intent of the study was threefold: to explore the initial state of adolescents with mild mental disabilities in awareness and use of memory strategies; to study the feasibility of implementing ecologically relevant tasks and multiple assessment procedures to measure this initial state; to examine their attributions about success and failure.

Subjects in this study were nine adolescents with mild mental disabilities (MMD) and ten children of average intelligence (AI) whose mental-age matched that of the MMD group. Teachers were requested to observe the subjects' memory and learning behaviors on different occasions and to complete Instrument No. 1. After the subjects were trained in the think-aloud procedures, tasks in Instrument No. 2 were administered to them individually by the investigator. They were required to suggest as many memory strategies as possible for the tasks without actually memorizing the tasks. Their verbal reports were tape-recorded for analysis. A week later, the subjects were tested again individually by the investigator with tasks in Instrument No. 3 which required them to actually memorize the memory tasks and think-aloud their strategies. Their verbal reports were tape-recorded for later analysis.

The results indicated that a multiple assessment approach (teacher observations, subject self-report and investigator assessment) using ecologically relevant tasks was feasible to provide global information on the entry-level memory strategy of the subjects. The results suggested that mildly mentally disabled subjects preferred to use maintenance rehearsal and visual imagery strategies. The frequency and range of strategies were smaller than that of the average intelligence subjects. In the area of attributions about success and failure, mildly mentally disabled subjects were likely to attribute their success to effort and their failure to lack of ability, effort and luck.

The findings of this study thus offered some support for teachers to utilize multiple assessment procedures with ecologically relevant tasks to

measure the initial state of memory strategies. Knowledge of this initial state would facilitate planning of strategy instructional programs. These findings were discussed in terms of research and educational implications.

ACKNOWLEDGEMENTS

This thesis could not have been completed without the support and assistance of a number of important people in my life. I wish to thank Dr. Robert Mulcahy, my academic advisor and thesis supervisor, for his critical thoughts and his generosity in sharing his expertise with me. His scholarly and professional advice proved to be invaluable. Dr. R. Mulcahy was never too busy to help, advise and encourage me, despite his very busy schedules. To him, I shall be forever grateful.

I extend my deepest appreciation to the other members of my committee, Dr. Robert Short, Dr. Fern Snart, Dr. Grace Malicky and Dr. Lorraine Wilgosh. Their thorough and constructive criticism of my work was most helpful. Their insight and advice, particularly during the candidacy and oral defence examinations, were appreciated.

Special thanks are extended to Dr. James Chapman for consenting to be my external examiner. Appreciation is extended to him for his thoughtful reading of the thesis, and for his insightful questions during the defence.

Special thanks are also extended to Mr. and Mrs. Ken Cheng, Miss Gina Wong and Miss Pam Mills who have contributed towards the completion of this thesis through scoring the results, editing and computer processing the final version of the thesis.

To my parents who instilled a love of learning and the belief that all things are possible through faith and endurance, I give my thanks and my love. To my son, Justin, I am especially grateful for his unflagging encouragement and support, and his love.

TABLE OF CONTENTS

CHAPTER		PAGE
I.	**INTRODUCTION**	1
	Rationale	1
	Purpose	3
	Definition of Terms	3
	Research Questions	5
	Significance	6
II.	**REVIEW OF LITERATURE**	7
	Introduction	7
	Cognitive and Metacognitive Processes	7
	Cognitive Characteristics of Persons with Mental Disabilities	14
	Cognitive and Metacognitive Strategies	22
	Cognitive and Metacognitive Strategy Assessment	28
	CA Matching Versus MA Matching in Research	45
	Specific Problems Presented in the Literature	48
III.	**METHOD**	50
	Introduction	50
	General Procedures	50
	Pilot Study	51
	The Main Study	55
	The Subjects	55
	The Setting	59
	The Instruments	62
	Scoring and Analysis	66
IV.	**RESULTS**	70
	Introduction	70
	The Results of Teachers' Perceptions and Observations	70
	Memory Strategies	71
	Attributions and Learning Behaviors	76

The Results of Subjects' Self-Reports 79
Memory Strategies 79
Attributions and Learning Behaviors 88
The Results of Investigator's Assessment 89
Memory Strategies 90
Integrations of the Results of the Three Instruments 101
Memory Strategies 101
Agreement of the Results of the Three Instruments 115
Attributions and Learning Behaviors 116
Conclusions 121
V. **DISCUSSION OF RESULTS AND CONCLUSIONS** 122
Introduction 122
Discussion of Results and Conclusions 122
Limitations of the Study 143
Research Implications 145
REFERENCES 148
APPENDICES 162
APPENDIX A: Subject Background Information Form 162
APPENDIX B: Instrument No. 1 -- Teacher
Questionnaire on Memory Strategies 164
APPENDIX C: Instrument No. 2 -- Subject
Self-Report on Memory Strategies 173
APPENDIX D: Instrument No. 3 -- Investigator
Assessment on Memory Strategies 177
APPENDIX E: Practice in Think-Aloud 184
APPENDIX F: Scoring Criteria and Sample Responses 185
APPENDIX G: Rating Sheet for Instruments No. 1,
No. 2 and No. 3 188

LIST OF TABLES

TABLE		PAGE
1.	Background Information on Subjects	60
2.	Descriptions of Subjects: Ages, IQ and CCAT Scores	61
3.	Nature of the Memory Tasks	69
4.	Teacher Observations and Prediction: Percentage and Frequency of Memory Strategies	73
5.	Teacher Observations and Prediction: Types of Memory Strategies	75
6.	Teacher Observations and Prediction: Attributions and Learning Behaviors	78
7.	Subject Self-Report: Interrater Reliability	80
8.	Subject Self-Report: Percentage and Frequency of Memory Strategies	81
9.	Subject Self-Report: Other Strategies	83
10.	Subject Self-Report: Types of Memory Strategies	86
11.	Subject Self-Report: Attributions and Learning Behaviors	87
12.	Investigator Assessment: Interrater Reliability	91
13.	Investigator Assessment: Percentage, Frequency of Memory Strategies and Percentage of Correct Responses	92
14.	Investigator Assessment: Other Strategies	95
15.	Investigator Assessment: Types of Memory Strategies	98
16.	Investigator Assessment: Percentage and Rank Order of Correct Responses by Nature of Tasks	100
17.	Summary of Overall Results: Memory Strategies by Subject	102
18.	Summary of Overall Results: Preferred Memory Strategies	106
19.	Summary of Overall Results: Memory Strategies and Nature of Tasks	109
20.	Agreement Between Teacher Perceptions and Subject Self-Reports: Attributions and Learning Behaviors	117

CHAPTER I
INTRODUCTION

Rationale

For children with mental disabilities, the current educational emphasis is placed on cognitive strategy training. This shift in emphasis is the natural outgrowth of the recent research on cognitive processes of these children and a change in educational goals from emphasizing the products of learning to emphasizing both the products and processes of learning (Weinstein, 1988).

Weinstein (1988) pointed out that the educational emphasis is now being placed not only on helping children to develop effective ways to handle the barrage of information coming from the environment, but also on the children's own thinking processes. The emphasis on children's thinking processes has led to the development of a variety of cognitive interventions, and the development and nurturing of cognitive strategies in students, including students with mental disabilities. Cognitive intervention programs essentially require the students to participate actively in their learning and to assume control of the learning situations (Brown, 1980). Studies have revealed that children with mental disabilities are likely to be passive learners and have difficulties in self-regulation (Whitman, 1990). Cognitive intervention programs are therefore needed to help them to overcome these difficulties as well as to learn.

To ensure successful cognitive interventions, it is essential to understand the cognitive characteristics and the educational needs of children with mental disabilities. Studies suggested that they may have attentional deficits, memory deficits (Robinson & Robinson, 1976), deficits in underlying knowledge base (Swanson, 1986), and strategic behavior deficits. As summarized by Justice (1985), persons with mental disabilities fail to adopt appropriate strategic behaviors in a variety of situations. Training efforts to remediate strategic deficits have often resulted in maintenance of the trained strategy but relatively limited evidence of generalization to new tasks or contexts. Some researchers

(Borkowski, Carr, Rellinger, & Pressley, 1990) hypothesized that noncognitive factors such as attributional beliefs and learning style could have an influence on strategy generalization.

Various suggestions have been made by researchers to remediate deficits of children with mental disabilities in knowledge base, memory and strategic behavior. Weinstein (1988) stressed the importance of improving memory abilities to strengthen the knowledge base. To improve memory abilities, strategy interventions are needed as developmental literature suggests that memory ability is characterized by the gradual accumulation of a repertoire of memory strategies and processes (Mulcahy, 1980). To remediate strategic behavior deficits, investigators have hypothesized that attributional beliefs regarding reasons for success or failure, and metamemory regarding the usefulness of alternative strategic interventions, relevant task characteristics, and other memory-relevant factors may play a critical role in strategy maintenance and generalization (Borkowski & Cavanaugh, 1979; Campione & Brown, 1977). To summarize, memory and metamemory development are important for children with mental disabilities to learn and to acquire a knowledge base, and strategy interventions help these children improve their memory performance and strategic behaviors.

To facilitate the successful implementation and evaluation of memory strategies intervention programs, an accurate diagnosis of each student's entry-level strategy is necessary. Although extensive research has been undertaken on assessing children's memory strategies, studies involving persons with mental disabilities are relatively limited (Wong, 1986). In addition, there are limitations in the design of the studies. The majority of the studies provided one or two experiences in prediction, recognition and recall (e.g., Flavell, 1970), using relatively artificial materials (e.g., nonsense syllables and related words), and the results were based on limited experiences of the subjects. It has been recognized for some time that children with mental disabilities may be more likely to spontaneously use strategies when a memory task is placed within a

natural setting (Bray & Turner, 1986). In order to gain a better measure of the subjects' entry-level memory strategies, multiple assessment (Meichenbaum, 1980) and utilization of more ecologically relevant tasks seem necessary (Bray & Turner, 1986). There is a need for development of an assessment approach and instruments that utilize ecologically relevant tasks and yield information about strategic behavior under a variety of conditions in natural settings. In addition, instruments for use by teachers who work with the children daily are particularly needed (Pauker, 1987).

Purpose

The purpose of the present study was to explore the mildly mentally disabled adolescents' initial state of awareness and use of memory strategies to learn and to retain new information. Their attributional beliefs regarding the reasons for success and failure and learning behaviors were also examined. The feasibility of implementing ecologically relevant assessment tasks and a multiple assessment approach (teacher observations, subject self-report and investigator assessment) to measure the initial state of memory strategy was studied. The assessment tasks and assessment approach were developed for use by teachers in schools and for obtaining information about initial state of memory behavior under a variety of conditions.

Definition of Terms

For the purpose of this study, the following definitions were adopted:

Adolescents with Mild Mental Disabilities (MMD)

These are specified as students having a Full Scale intelligence quotient in the range of 60-75 on the Wechsler Intelligence Scale for Children-Revised (WISC-R). The average standard error of measurement is 3.19 for WISC-R Full Scale. These students have no outstanding physical, sensory, behavioral, language, attentional or cultural deficits that may interfere with the

progress of the study. They are within the age range of 14 years to 15 years and still studying in school.

Children with Average Intelligence (AI)

These are specified as children having their Canadian Cognitive Ability Test (CCAT) verbal and non-verbal scores within one standard deviation above and below the mean. Their chronological age matches the mental age of the MMD group. Their general achievement level, as measured by the Canadian Tests of Basic Skills (CTBS), is within one standard deviation above and below the mean. They have no outstanding physical, sensory, behavioral, language, attentional or cultural deficits that may interfere with the progress of the study.

Attributions

For the purpose of this study, attributions are restricted to attributions of success and failure. Research indicated that achievers tend to attribute success to thoughtful strategies and effort. When they fail, they attribute their difficulties to the selection of inappropriate strategies or lack of effort (Borkowski, 1992). This pattern of attributional belief is the reverse of disabled students.

Metamemory

Metamemory refers to an individual's knowledge and awareness of how his/her own memory works in various memory situations (Flavell, 1970).

Memory Strategies

Memory strategies denote a wide variety of activities performed by students while they are attempting to acquire target information in their working memory. The types of memory strategies included in this study are maintenance rehearsal, elaborative rehearsal, visual imagery, and mnemonic devices.

Rehearsal describes the process of repeating something over and over to oneself (Andre & Phye, 1986). This study adopts Craik and Lockhart's (1972) distinction between two types of rehearsal activities: maintenance and elaborative rehearsal. Maintenance rehearsal involves rote repetition or the

recycling of items in memory while the depth of encoding remains unchanged. Elaborative rehearsal relates the to-be-remembered information to other information already known and increases the depth of encoding. Elaborative rehearsal includes strategies for categorizing, grouping, or using meaningful relationships among to-be-remembered items in order to render them more memorable.

Visual imagery strategy describes the forming of mental pictures of the to-be-remembered materials to facilitate better memory.

Mnemonic devices involve embellishing the incoming materials by creatively interrelating the items-to-be-learned or by associating the items to a previously learned set of peg words or images (Weinstein & Underwood, 1985). Examples of mnemonic techniques include the Peg method, Loci method, the Link method, first-letter mnemonics, and the keyword method.

Research Questions

To achieve the purposes of the study, answers to the following research questions were sought:

Initial State of Memory Strategies

1. Do subjects with mild mental disabilities (MMD) use memory strategies when they learn new information?
2. Which type of memory strategies (maintenance rehearsal, elaborative rehearsal, visual imagery, mnemonics) do MMD subjects use more often?
3. What other strategies do MMD subjects use when they remember new information?
4. Are there any differences in the initial state of memory strategies between MMD subjects and subjects with average intelligence (AI)?

Attributional Beliefs

5. Are there any differences between MMD and AI subjects in their learning behaviors and attributions of success or failure?

Feasibility of the Assessment Approach

6. Can a multiple assessment approach (teachers' observations, subjects' self-reports, and investigator's assessment) yield a global picture of MMD subjects' entry-level memory strategies?

Significance

The significance of this exploratory study rests with the generation of information concerning the measurement and nature of memory strategies reported to be used by MMD subjects. Some initial information on the awareness and use of memory strategies, and the feasibility of ecologically relevant assessment tasks and a multiple assessment approach was generated. This initial information should assist in the development of more detailed long term and group studies. It may help to delineate the direction a classroom teacher can follow to design assessment tasks and to investigate the entry-level strategies in other areas before instruction begins.

CHAPTER II
REVIEW OF LITERATURE

Introduction

Wong (1986) indicated that cognitive psychology has filtered through to two areas in special education: learning disabilities and mental disabilities. The amount of research on cognitive approaches for persons with mental disabilities is relatively less than that for persons with learning disabilities. This study addresses the former group of students.

The review of literature is organized under six major headings. The first section focuses on cognitive and metacognitive processes including memory processes and self-regulation. The second section summarizes the cognitive characteristics of people with mental disabilities. The third section presents different types of cognitive and memory strategies. The fourth section summarizes major assessment issues. The fifth section discusses chronological age matching and mental age matching in comparative research. The concluding session outlines the problems arising from the literature.

Cognitive and Metacognitive Processes

Despite the widespread use of the term cognition, to find a unanimous definition of cognition has proven to be a difficult task (Forrest-Pressley & Waller, 1984). Kirby (1984) refers to cognitive processing as a function involved in the actual encoding, transferring, storing and retrieval of information. Sternberg (1986) describes three distinct types of cognitive processes: knowledge-acquisition components, performance components, and metacognitive components. Ashcraft (1989) defined cognition as "the collection of mental processes and activities used in perceiving, remembering, and thinking, and the act of using those processes" (p.10). His notion of cognition is a broad all-inclusive one which covers more than the traditional narrow intellectual processes such as problem solving, and extends to include emotional awareness. From the above definitions, it seems that cognition

embraces a wide scope of psychological entities ranging from perception, memory, reasoning, social judgement, and so forth. Flavell (1985) argued for a broad and complex conception of cognition because cognitive processes frequently intrude themselves into most of the human psychological processes and activities.

If cognition involves the processes as described by Ashcraft (1989), then metacognition (i.e., knowledge of cognition) is concerned with thinking about one's own perceiving, remembering, thinking and the act of using those processes. Flavell (1981) has extended his definition of metacognition to include "metacognitive knowledge" as well as "metacognitive experience". Brown (1981) has also differentiated metacognition into two components: "knowledge about cognition" and "regulation of cognition".

In this literature review section, three aspects of the cognitive and metacognitive processes, which are most relevant to the focus of this study, are presented in more detail. These three aspects are the encoding process, memory and metamemory processes, and self-regulation.

Encoding Process

Encoding, one aspect of cognitive processes, determines how input information is initially analyzed (Swanson, 1987), stored and remembered (Kulhavy & Schwartz, 1986). Encoding therefore denotes a wide variety of activities performed by individuals while they are attempting to learn and acquire target information. The primary influences on encoding are attention, depth of processing and knowledge base (Kulhavy & Schwartz, 1986).

Cook & Meyer (1983) analyzed the encoding process into four main components:

Selection.

The learner actively pays attention to some of the information that is impinging on sense receptors and transfers the information into working memory. The notion of selective attention is important here. As children mature, they become adept at channelling their attention to the most informative

aspects of information. They become able to ignore irrelevant or less informative aspects of material. Brown (1981) pointed out that selective attention is influenced by three main factors: strategies (as children mature they show a marked tendency to introduce a variety of increasingly ingenious ploys to aid learning); metacognition (as children mature they acquire more knowledge concerning methods and procedures for studying and the match between the task at hand and their available repertoire of strategies); and content knowledge (as children mature, they acquire more knowledge about the world around them. This increased content knowledge influences how they selectively attend, and how they tailor their learning process).

Acquisition.

The learner actively transfers the information from working memory into long-term memory for permanent storage.

Construction.

The learner actively builds connections between ideas in the information that have reached working memory. This building of internal connections involves the development of a coherent outline organization or schema that holds the information together.

Integration.

The learner actively searches for prior knowledge in long-term memory and transfers this knowledge to working memory. The learner may then build external connections between the incoming information and prior knowledge.

According to Cook and Meyer's analysis (1983), selection and acquisition are cognitive processes that determine how much is learned whereas construction and integration are processes that determine the organizational coherence of what is learned, how it is organized, the depth of processing, and therefore how well the material is remembered.

Memory and Metamemory

Knowledge about memory, termed metamemory, concerns knowing about variables that are believed to influence any aspect of memory (Cavanaugh & Perlmutter, 1982). Several models of memory functioning have included metamemory as a factor in determining performance levels. According to Flavell (1981), an awareness of item characteristics, task demands, personal attributes, and strategies would interact to directly affect memory performance. Brown (1975) identified "knowledge about knowledge", which was defined as task-relevant knowledge or metamemory, as a distinct dimension of knowledge undergoing developmental change and assumed to be related to developmental increases in memory performance. In subsequent discussions, Brown (1982) included metamemorial knowledge as a characteristic of the learner relevant to task performance. Similarly, Pressley, Borkowski, and Schneider (1987) noted the importance of "executive functioning". In their model, the "executive" selects, monitors, modifies, and evaluates the effectiveness of strategic behaviors. In each of these models, metamemory is hypothesized to play an important role in the development of memory performance.

Theoretical discussion and research included under the rubric of metamemory has addressed two different, although not independent, aspects of memory (Justice, 1985). One is the individual's knowledge about memory processes, while the second involves the person's ability to monitor and regulate those processes. Knowledge about cognition comprises the relatively stable information of the individual concerning limitations, abilities, and relevant variables within a particular domain (Brown, Bransford, Ferrara, & Campione, 1983). The knowledge is fallible in that it may or may not be accurate and is at least potentially stable in that the person should be able to demonstrate awareness of the pertinent information. Regulation of cognition, in contrast, is a dynamic process of controlling the functions of a particular domain. Brown

(1983) suggested planning, monitoring and checking as important regulatory processes in cognition.

Self-Regulation and Attributional Beliefs

The initial focus of metacognitive theory during the past two decades of instructional research was on teaching students an awareness of the attributes of specific strategies (Borkowski, Milstead, and Hale, 1988). A second focus centred on the higher order self-regulating skills that appear essential for generalized strategy deployment (Zimmerman & Schunk, 1989). The most recent extension of metacognitive theory encompasses noncognitive influences on performance such as attributional beliefs and learning styles (Borkowski, Carr, Rellinger, & Pressley, 1990). The fundamental premise in the recent version of metacognition is that personal-motivational factors energize the self-regulating executive skills necessary for strategy selection, implementation, and monitoring. Deficiencies in one or both processes account for many of the individual differences that separate gifted, regular and learning-disabled children.

As regulatory behaviors and attributions of success and failure are being addressed in this study, the following discussion focuses on the influence of self-regulation and attributional beliefs on cognitive strategy performance.

Self-Regulation.

For cognitive theorists, to self-regulate is to analyze, plan and then act (Whitman, 1990). They emphasize the nature of the planning process, in particular people's self-examination of what they know about the structure of the tasks they are confronting, their own strategic resources, and the interface between these task demands and personal resources. Self-regulation is essential for learning, transfer of learning and generalized strategy use. Brown (1987) noted that active learners continuously adjust and fine tune their actions via self-regulating processes.

In addition to analyzing, planning, and acting components, some

researchers hypothesized the importance of task involvement and attributional retraining to enhance self-regulation and strategy generalization.

Task involvement and self-regulation.

Borkowski et al. (1992) hypothesized that motivational processes and the self-system were intimately related to the development of self-regulation, the component of metacognition essential for generalized strategy use. They suggested that strategy-based instructional programs that enhanced students' task involvement should result in greater generalization because these programs reduced comparisons between one's own performance and that of peers. Nicholls (1989) defined the concept of task involvement as "a state where performing, understanding, or completing a task is important in its own right" (p.88). Students who are task involved are less concerned about proving their abilities and more interested in understanding or solving problems. They choose challenging problems that enable them to exercise and expand their skills. When they are successful, they attribute their success to thoughtful strategies and effort. When they fail, they attribute their difficulties to the selection of inappropriate strategies or lack of effort. Importantly, they seem to expect errors as part of the learning process; thus they do not give up when they fail, but they try again, perhaps looking for a better strategy. Borkowski et al. (1992) suggested that the children's definition of success (getting better versus being the best), failure (making understandable mistakes versus being stupid), and attributions about the causes of success and failure (ability, effort, or appropriate strategy choice) would change under circumstances of task involvement.

Interestingly, the task-oriented learner described by Nicholls (1989) is similar in many ways to the self-regulated learner described in the metacognitive literature (Borkowski et al., 1992). Both are likely to use the most sophisticated strategies available for solving complex tasks, despite the effort required. Both monitor their performance, switching or modifying strategies if necessary. Finally, both are more likely to attribute success to strategy-related

effort and failure to lack of effort or to the use of inappropriate strategies. In short, a task orientation is likely to prompt the emergence of self-regulation.

Attributions and self-regulation.

Some researchers focused on incorporating motivational constructs, primarily people's attributional style, into their theories to account for individual differences in strategy generalization and into their interventions to improve strategy instruction (Borkowski, Milstead, & Hale, 1988). They pointed out that children who do not have a sense of control are less persistent, have poor expectancies for future tasks and negative self-concepts, and generally do not use viable learning strategies. Borkowski et al. (1992) suggested that such attributions, which arise from the performance of lower order skills, can, in turn, inhibit the development of higher level executive processes. From this perspective, dysfunctional attributional beliefs may alter the effectiveness of the entire metacognitive-motivational system, especially as it is related to acquiring, applying, and modifying strategies (Borkowski, Carr, & Pressley, 1987).

Some studies seem to support the importance of attributional beliefs in strategy instruction. In their work with learning-disabled children, Jacobsen, Lowery, and Ducette (1986) found dysfunctional attributional beliefs to be a major reason for the failure common to children with learning disabilities, who tend to attribute success to external factors such as task difficulties or luck and to attribute failure to internal factors such as effort. This pattern of attributional beliefs is the reverse of typical achievers. The studies of Borkowski, Weyhing, and Carr (1988) and Carr and Borkowski (1989) showed that the effects due to summarization training on comprehension performance were magnified about 50% when attributional retraining was added to the traditional strategy instructions. The intervention program in the Reid and Borkowski (1987) study found that attributional retraining produced long-term performance gains and spontaneous strategy use in learning-disabled and hyperactive students when combined with self-regulation and strategy training.

In sum, children's successes are dependent in part on their beliefs that effort counts and that they are in control of academic progress. There is otherwise little reason for them to apply strategies to problem-solving tasks and to acquire metacognitive knowledge. If the impetus for achievement is external to children (e.g., a belief in luck or in the necessity of help from others), it is unlikely that they will develop feelings of self-esteem and a repertoire of high-level metacognitive skills necessary for good performance (Borkowski et al. 1992).

Cognitive Characteristics of Persons with Mental Disabilities

Cognitive Deficits

In addition to the general reduction in ability to learn, there are a number of specific cognitive deficits that have been noted among individuals with mental disabilities. They may have attentional deficits and memory deficits (Robinson & Robinson, 1976). These problems, however, may tie to their inability to use appropriate learning strategies such as mediation (Hallahan & Kauffman, 1982). Studies on memory performance of children with mental disabilities have produced conflicting results which suggest their memory deficiencies represent a continuum from structural deficits to central nervous system processing difficulties (Swanson, 1987). Borkowski et al. (1986) suggested that such memory difficulties may be a result of lack of metamemory awareness. Studies indicated that persons with mental disabilities have strategic behavior deficits. They do not use strategic behaviors spontaneously and have difficulties selecting, modifying, and sequencing strategies (Campione & Brown, 1977). In addition to memory and strategic behavior deficits, people with mental disabilities may have a self-regulatory disorder. Whitman (1990) considered the reconceptualization of self-regulatory disorder being compatible with the general descriptions of persons with mental disabilities who are likely to be dependent and have an external locus of control. They tend to look to others for

assistance because of their inability to self-regulate their behavior effectively.

In the area of strategy learning, persons with mental disabilities often fail to generalize the strategies they have learned to other situations. Training efforts to remediate strategic deficits have often resulted in maintenance of the trained strategy but relatively limited evidence of generalization to new tasks or contexts (Justice, 1985). Some studies (e.g., Swanson, 1986) indicated that the dramatic differences between disabled and non-disabled children reflect not only strategic or control processing, but also differences in the underlying knowledge base which place formal restrictions on the class of logically possible strategies that can be used within a given academic domain.

Memory and Metamemory

A general discussion on memory and metamemory has previously been outlined. This section addresses research on memory and metamemory which is related to mentally disabled persons, rather than specifically to mentally disabled adolescents, since research on the latter group was relatively limited.

Developmental changes in knowledge about memory.

Research data suggested that there were developmental increases in some aspects of knowledge about memory among mentally disabled individuals. Some of these aspects are reviewed below.

1. Effect of certain variables on memory performance -- Children with mental disabilities appear to develop awareness of the effects of certain variables such as interference and retention interval on memory performance at approximately the same point as their MA matched peers. Brown (1978) found that the majority of both MA 6 and MA 8 disabled children were aware that stopping to get a drink of water would interfere with the recall of a telephone number, although only the older children could generate a strategy for retaining the information. Eyde and Altman (1978) also found an increasing awareness of the effect of retention interval, with older children more likely to choose immediate over delayed recall.

2. Benefits of increased study time -- Results of studies suggested developmental changes in awareness of the benefits of increased study time for children with mental disabilities. Brown (1978) found that, although both MA 6 and MA 8 students realized that studying for 5 minutes would help them to remember more than studying for 1 minute, older and more experienced children were more likely to explain their choice adequately. Friedman, Krupski, Dawson, and Rosenberg (1977) found that 15 of their 22 mentally disabled young adults said that studying 5 minutes would help an individual to remember more. In addition, the authors noted that several subjects, who indicated that the person studying 1 minute would remember more, nevertheless appeared to be responding based on a memory-relevant dimension. Their rationale was that the individual studying only 1 minute obviously had superior memory abilities and therefore would remember more.

3. Ability to generate strategies for future recall -- The study of Eyde and Altman (1978) found developmental increases in the ability of individuals with mental disabilities to generate strategies designed to prepare for future recall. The researchers asked their subjects to generate appropriate strategic behaviors to aid recall of specific objects or events. Across the wide age and ability range included in this study, a linear increase with chronological age was found in the number of strategies generated, while higher mental age subjects generated more strategies than lower mental age subjects. The quality of the suggested strategies also changed with age. Older subjects tended to propose external retrieval cues, while younger subjects were more likely to suggest an internal cue. This finding is an interesting contrast to the Kreutzer (1975) data indicating a strong reliance on external devices among normal children. The Friedman et al. (1977) study suggested that although the number and range of strategies generated by children with moderate mental disabilities are smaller compared with normal children, they appear to develop some awareness of methods to increase their probability of recall.

Aspects of metamemory without developmental changes.

In contrast to the findings of studies discussed above, no increases with age have been found in awareness of the benefits of relearning previously learned material (Eyde & Altman, 1978), awareness that items embedded in context are easier to recall than unrelated items, ability to generate strategies to remember a set of categorizable items, or the awareness that semantically related word pairs (opposites) would be easier to remember than arbitrary pairs (Brown, 1978).

To summarize, data suggest that there are developmental increases in some aspects of knowledge about memory among children with mental disabilities between the mental age of 5 and 16 years. Although relatively little developmental change is apparent between MA 6 and 8 (Brown, 1978), over a broad age range children with mental disabilities show increased awareness of the effects of variables such as interference, amount to be remembered, and strategy. For other dimensions, such as awareness of the effects of context and the mnemonic significance of semantic relationships, little developmental change is apparent. Justice (1985) summarized the data available on metamemory in the mentally disabled and concluded that metamemorial knowledge of persons with mental disabilities might be more impoverished and less accurate than that of normal functioning individuals but it might be expected that the individuals with mental disabilities would hold some beliefs and attitudes concerning memory.

Regulation of memory.

A basic requirement for regulation of memory processes is the individual's ability to assess the current state of the memory system. The "feeling of knowing task" was used to examine the ability to evaluate the availability of information in memory. Two studies on the feeling of knowing in mentally disabled children with mental ages between 6 and 10 years were conducted by Brown and Lawton (cited in Brown, 1978). Results indicated that developmental changes were apparent among children with mental disabilities

in the ability to assess the current state of their memory systems. The feeling of knowing task, however, appears to require a minimal amount of regulatory ability. The child makes only a judgement of the probability of recognition, without the necessity of a further behavioral change in response to this judgement. Tasks requiring the initiation of strategic behavior on the basis of metamemory knowledge present a more complex situation.

The "recall readiness task" was also designed to assess the child's ability to monitor the current state of the memory system. It requires, however, strategic behavior to achieve a desired end state. The subject is given a set of pictures and asked to study them until they can be recalled perfectly (Flavell, 1970). This task requires a complex series of behaviors, including selection of an appropriate strategy, executing the strategy, continuous monitoring of the state of the to-be-remembered items, and evaluating when the items have been thoroughly learned. Brown and Barclay (1976) found that initial performance of MA 6 and MA 8 mentally disabled children on the task was poor. A total of 60 of the 66 children failed to have even one perfect recall trial. Hypothesizing that these results might reflect the unavailability of an appropriate strategy for the task, the children were then trained to use one of the three strategies: anticipation, rehearsal, or labelling. Training for 2 days was followed by a prompted post-test 1 day after the training, and three unprompted post-tests were given 1 day, 2 weeks, and 1 year after training. Both groups showed increased memory-monitoring ability on the prompted post-test. On the unprompted post-test, however, MA 6 children returned to their pre-training level of performance. The MA 8 children, in contrast, maintained performance above pre-training levels on all three post-tests. Thus, acquisition of an appropriate mnemonic was accompanied by increased monitoring of strategic effectiveness by MA 8 disabled children, and this increase was maintained up to 1 year later.

"Study time apportionment" ability, that is, the strategic focusing of study time on items that have not yet been mastered, was investigated by Brown and

her colleagues (Brown & Campione, 1977a). In this task, children are given a set of items to study for free recall. After each study-test set, however, the subjects are allowed to select only a subset of the items for additional study. An effective strategy in this situation is to choose previously-missed items for additional study. Brown and Campione (1977a) administered the study time apportionment task to groups of MA 6 and MA 8 disabled children. Initial performance on the task indicated that neither mentally disabled group showed strategic selection of items to be studied. Following pretesting, the children were trained to use one of three mnemonic strategies by having the experimenter select the subtest of items to be studied further. The three strategies involved were the standard strategy, the creeping strategy and returning random items for further study. Results indicated that none of the strategies was effective in increasing study time apportionment or recall for the younger children. For the older children, training on the standard strategy resulted in maintenance of this strategy on the post-test and concomitantly higher recall scores. Thus, similar to findings on the recall readiness task, training of specific mnemonic techniques was sufficient to increase regulatory abilities in developmentally older disabled children.

To summarize, the limited data available on the regulatory abilities of children with mental disabilities indicate that without training, children with mental disabilities show only low-level monitoring of the current state of memory. There is some indication that MA 6 and MA 8 children can judge the strength of an item in memory (feeling of knowing), but they do not spontaneously utilize this information to select, initiate, or modify strategic behaviors. Training in the use of mnemonic strategies appears to result in increased memory monitoring by disabled children with mental ages at or above 8 years. Based on findings of these studies, Justice (1985) concluded that the ability to select and execute a response may exceed the capabilities of the mentally disabled. Research indicated that awareness of relevant memory variables did not always coincide with appropriate behavioral responses

(Justice, 1985; Moynahan, 1973). Justice (1985), therefore, suggested that mentally disabled persons possess some knowledge and beliefs about memory without necessarily having the ability to regulate them effectively.

Metamemory and strategy use.

One of the questions posed by models which include metamemory as a factor in memory performance concerns the relationship between metamemory and strategy use. It was hypothesized that if an individual is aware of the mnemonic benefits of a behavior for a certain task, that behavior will be adopted in response to the task (Brown & Barclay, 1978). A number of studies with both normal (Cavanaugh & Borkowski, 1980) and mentally disabled individuals have examined this relationship. Brown (1978) and Eyde and Altman (1978) looked at the relationship between judgements concerning the mnemonic benefits of a strategy and strategy use in a memory task situation. Results of Brown and Barclay's study (1976) indicated that only 36% of the younger and 19% of the older children actually executed the strategy they judged to be most effective. Even immediately following the strategy judgement and using identical stimulus items, there was little relationship between the memory knowledge and strategic behavior of children with mental disabilities. The relationship was also low for normal 4- and 6-year-olds in this study. However, 77% of the normal 8-year-olds adopted one of the two strategies they had identified as effective. Eyde and Altman (1978) examined a similar question by looking at the relationship between awareness of the benefits of organization for increasing recall and use of a categorization strategy on a recall task. No relationship was found between metamemory judgements and strategic behavior at any age between 5 and 16 years. Thus, investigations have failed to establish the development, in mentally disabled children, of a relationship between awareness of the benefits of specific strategic behaviors and their adoption.

To summarize, research has indicated only moderate correlations (Cavanaugh & Perlmutter, 1982) between metamemory and strategy use.

Generally, little relationship between metamemory and strategy use has been found for developmentally young and mentally disabled children (Brown & Barclay, 1976; Schneider, 1985). Some relationship has been found for older mildly mentally disabled (Brown & Barclay, 1976). However, it has been demonstrated that extensive training may result in an increased relationship (Kendall 1980).

Metamemory and memory performance.

The hypothesized relationship between metamemory and strategy use is the basis for the further assumption of a relationship between metamemory and memory performance. Children with mental disabilities exhibited production deficiencies on virtually all short-term memory tasks (Flavell, 1970). That is, they fail to spontaneously adopt strategies which they are capable of executing. When trained to adopt appropriate strategies, however, they can efficiently execute the strategies, and recall levels increase (Borkowski & Cavanaugh, 1979; Hagen & Stanovich, 1977). The inference is that if metamemorial development results in increased strategy use, this will, in turn, be reflected in higher memory performance. An alternative possibility, however, is that metamemory may result in increased strategic behavior, but without concomitant increases in recall. Research to date is equivocal. The majority of the studies have found little relationship between metamemory and memory performance (Justice, 1985; Kramer & Engle, 1981), while a few studies have identified at least a tentative relationship (Eyde & Altman, 1978; Kendall, 1980). Although the data are not consistent, the fact that some studies have found a relationship between metamemory and memory performance suggests that a reliable measure of metamemory, particularly reflecting a broad awareness of memory-relevant variables, may predict subsequent memory performance. Such findings underscore the importance of understanding metamemorial development for increasing the memory abilities of the mentally disabled.

Cognitive and Metacognitive Strategies

Deshler and Alley (1979) defined cognitive strategies as those techniques, principles or rules that will facilitate the acquisition, manipulation, integration, storage and retrieval of information across situations and settings. According to Flavell (1981), strategies are one component of cognitive monitoring. These strategies are actions undertaken to further and assess cognitive progress. Strategies should be applied flexibly and the learner must know when, where, and how to use them (Brown, Armbruster, & Baker, 1986). In other words, strategies are different from tactics in that the latter are blind techniques deployed to a given task without an understanding of how and why they work (Snowman, 1986). When strategies become automatic, they become skills (Paris, Lipson, & Wixson, 1983).

There are different types of cognitive strategies such as domain specific and general strategies. Addressed here are strategies which tend to have a rather broad application across content areas. It appears that this is true of strategies for attention, encoding, retrieval, thinking, and general problem solving (Mulcahy, Marfo, Peat, & Andrews, 1986). However, Gagne (1977) points out that the development and effective utilization of cognitive strategies depend upon internal as well as external conditions because "although cognitive strategies are themselves free of specific content, they cannot be learned or applied without some specific content" (p.37). When this is applied to the memory process, it means that previously learned categories, their recallable labels and knowledge constitute the internal materials upon which a chosen encoding strategy such as elaborative rehearsal will be based.

Flavell (1981) suggested a distinction of cognitive strategies from metacognitive strategies. Cognitive strategies are used to make cognitive progress whereas metacognitive strategies are used to monitor the cognitive progress. Examples of such cognitive and metacognitive strategies are verbal rehearsal, allocation of attention, text summarization, self-questioning, referring

to an expert source, etc. (Garner, 1987; Lupart, 1984). It should be noted that a strategy can be cognitive in one case and metacognitive in another. For example, self-questioning is a cognitive strategy if it is used to synthesize information, and it is also a metacognitive strategy if it is used to monitor comprehension.

Memory Strategies

Memory strategies refer to strategies which influence how information is learned, stored and remembered (Kulhavy & Schwartz, 1986; Swanson, 1987). Addressed in this study are three general types of memory strategies -- rehearsal, visual imagery and mnemonics -- which are considered important for persons with mental disabilities. These three types of strategies, though discussed separately, are closely interrelated.

Rehearsal.

In general, rehearsal is defined as the process of repeating something over and over to oneself (Andre & Phye, 1986). Rehearsal has been studied very intensely by developmental psychologists. This interest was partially motivated by the criticality of rehearsal in both multi-store memory models (Atkinson & Shiffrin, 1971) and levels of processing models (Craik & Lockhart, 1972). In Atkinson and Shiffrin's model, the structural components are the sensory registers, long- and short-term memories. Rehearsal is part of the control processes which helps to extend the limited capacity of short-term memory and to increase the probability that incoming information will reach the unlimited capacity long-term memory. Craik and Lockhart (1972) replaced the notions of a multistore model with a conception that defines the "depth" or level of processing of incoming information. While shallow processing is associated with attending more to physical features of a stimulus, deeper processing involves more complete and meaningful processing. Craik and Watkins (1973) attempted to distinguish two types of rehearsal: maintenance and elaborative rehearsal. Maintenance rehearsal is a form of shallow processing which involves the repetition of to-be-remembered information for short-term recall

while the depth of encoding remains unchanged. Elaborative rehearsal is a deeper processing which includes strategies for categorizing or otherwise grouping to-be-remembered items or using meaningful relationships among items in order to render them more memorable. This process increases the depth of encoding. Thus, rehearsal serves two functions. It may be used to recirculate an item through short-term memory and to move an item from short-term memory to long-term memory (Detterman, 1979).

Ellis (1970) has suggested that persons with mental disabilities have a rehearsal deficit and they are less capable of taking advantage of rehearsal opportunities. Detterman (1979) observed that although disabled subjects displayed a rehearsal deficit, when they were instructed to rehearse, they were able to do so. He concluded that mentally disabled people's rehearsal abilities were essentially intact. They were deficient in the ability to select the appropriate strategy for a particular task. The process responsible for strategy selection is metamemory. Detterman (1979) also found that training in rehearsal strategies facilitates memory and metamemory performance.

Visual Imagery.

Other strategies recommended for use by persons with mental disabilities are visual imagery and mnemonic devices. Visual imagery describes the forming of mental pictures of to-be-remembered material to facilitate recall. Visual imagery is known to be an important factor in the quality of performance on a variety of cognitive tasks (Sears & Johnson, 1986) and it has been used quite effectively in helping young children learn to read and spell (Mulcahy, 1980). Children with mild mental disabilities do not spontaneously use visual imagery to facilitate recall. When they do, however, their recall performance increases (Mulcahy, 1980). Pressley (1990) stressed the importance of imagery training for children with mental disabilities. He pointed out that these children's language is often underdeveloped while certain prerequisite linguistic abilities are needed to understand and to apply the strategy intervention programs appropriately. He considered overcoming language problems as more difficult

than avoiding them by relying on a presumed nonverbal representational system - imagery. Whitman (1990) discussed the importance of visual mediators for mentally disabled children from a developmental perspective. He stated that visual mediators guide human behavior before verbal cues and continue to guide performance throughout life. Due to language deficiencies of mentally disabled persons, it is likely that they mediate their responses more through visual than verbal cues. Thus, Whitman (1990) recommended emphasizing the use of visual cueing techniques when teaching these individuals during the early stages of instruction.

Mnemonics.

Mnemonic strategies are practical techniques that help to make information more memorable and easily retrievable (Baine, 1986). Some mnemonic strategies involve the elaboration of information. Alternatively, some mnemonic techniques involve reduction of the amount of information to be memorized. Most mnemonic strategies involve the use of visual imagery. For the purpose of this study, Weinstein and Underwood's (1985) specification of mnemonics is adopted. Mnemonics are specified by them as those strategies which embellish the incoming material by creatively interrelating the items-to-be-learned or by associating the items to a previously learned set of peg words or images. Examples of mnemonic strategies include the Peg method, Loci method, the Link method, first-letter mnemonics, and the keyword method. Mnemonic strategies, such as the keyword method and the method of loci, rely upon the acoustic properties of unfamiliar words and the learner's own visual imagery to establish a connection between stimulus and response information. Since memory for acoustic similarities and memory for pictures appear to be less developmentally sensitive than other types of memory (Torgesen & Kail, 1982), children who are less developmentally advanced, such as the mentally disabled, would be expected to benefit from mnemonic techniques (Scrugg & Mastropieri, 1990).

Studies on the Use of Strategies

In their study to test mentally disabled and non-disabled children in a recall readiness task, Turner and Bray (1985) allowed the participants to control the presentation sequence and the number of re-presentations of the to-be-remembered items. Participants in the any-order condition could view the items as many times as desired in any order. Those in the forward-order condition could view the items as many times as desired, but only in a forward (left-to-right) order. The mean number of repetitions did not differ for the any-order and forward-order conditions for either intelligence group. Overall, however, the non-disabled group repeated the items more than the disabled group did. Further, the types of strategies used by disabled and non-disabled children differed. In the any-order condition, both intelligence groups tended to repeat the entire set in sequence, but the non-disabled children were more likely than the disabled children to repeat the items within a sequence in small groups (chunks). Thus, under these conditions, children with mental disabilities used repetition strategies but the strategy types reflected less sophisticated organization schemes than the strategies used by non-disabled children of the same chronological age.

The same study examined the influence of task context. It has been recognized that children may be more likely to spontaneously use rehearsal when the memory task is placed within a naturalistic context. The researchers found that most subjects used rehearsal when given a task that did not constrain the number of times or the order in which they were allowed to study the items to be recalled. Traditional sequential memory tasks restrict both of these aspects of study behavior. It is likely that the removal of these constraints results in a task which is easily placed in a familiar context. This may increase comprehension so as to reveal the necessity for, and the possibility of, strategy use.

Other studies (e.g., Buckhalt, Mahoney, & Paris, 1976) have investigated the role of mediation and elaboration in the encoding of information. Subjects

were asked to associate words-to-be-remembered together with another word (the mediator) and to elaborate the materials-to-be-remembered by constructing sentences or by inserting additional words in the materials. These studies often found subjects with mental disabilities to perform more poorly than normal subjects. If the experimenter modified the situation by providing the mediator or elaborations or by instructing the subjects on how to apply their own, performance for disabled subjects was generally facilitated.

If rehearsal processes, which are dependent on verbal processes, are deficient in people with mental disabilities, then arranging the stimulus situation so that they are able to encode nonverbal aspects of the stimuli should facilitate memory performance of the subjects. Memory studies by Taylor, Josberger and Whitely (1973) have found that instructions to use verbal imagery or verbal mediation facilitate performance in subjects with mental disabilities. The results of this study indicated that an imagery pegword device improved memory performance of disabled subjects but the facilitation was only slightly greater than that found for normal subjects. Further, this study also indicated that imaging disabled subjects performed at a level about equal to that of uninstructed normal control subjects.

In the area of mnemonic competence in mentally disabled persons, the study of Ellis, Katz, and Williams (1987) indicated that mentally disabled subjects did not differ from non-disabled subjects in their recall of names of pictures and location. In their study, subjects looked at books in which each page was divided in quadrants, with a different picture in each quadrant. Subjects were asked to recall the names of the pictures. Mentally disabled adolescents recalled about as many picture names as did 10-year-olds. However, their recall of locations did not differ from adults' recall. In a subsequent study, Ellis, Palmer, and Reeves (1988) had subjects remember 30 pictures. Some pictures were shown only once; others were shown two, three, or four times. After viewing the pictures, subjects were asked to recall the names of the pictures and to estimate the frequency with which they had seen

the pictures. For recall of names, mentally disabled adolescents performed at about the same level as non-disabled 11-year-olds. However, their estimates of frequency were just as accurate as those made by non-disabled adults. Based on the results of these studies, Ellis et al. (1988) suggested that the frequency of occurrence, spatial location, and temporal location were apparently intact and functioning in most humans, even when other mnemonic and cognitive processes have been disrupted.

Some studies (cited in Schneider & Pressley, 1989) have investigated gender differences in memory strategy usage and did not find any significant results. Zimmerman's study (1989) investigated the grade and gender differences in self-regulation. He found that boys had higher verbal and mathematics efficacy while girls were better in record-keeping and monitoring. However, results of his study were not consistent with other studies and therefore further investigation was suggested. In sum, it is not clear whether there are gender differences in memory strategy usage.

Cognitive and Metacognitive Strategy Assessment

The Need for Assessment

Assessment is the process of gathering data for the purpose of making decisions about or for individuals (Ysseldyke, 1979). The promise of methods for assessing cognitive strategies is that they can help us understand the processes that underlie performance. Before cognitive strategy training for children with mental disabilities is implemented, it is essential to measure the entry-level cognitive strategies of these children. If an assessment indicates that an individual's poor performance can be traced to ineffective strategies in certain cognitive processes, then the assessment may be useful not only for diagnosis but for suggesting remediation as well (Siegler, 1989). After strategy training is conducted, assessment also helps us to determine how effectively strategies are being taught in the classroom and can lead to the further development of instructional programs.

Assessment Procedures

Stiggins (1988) identified the need for assessment procedures for teachers who are the major users of such procedures. He stated that, in the classroom, it is the teachers who work with the students daily and who assess student progress. They have constructed or selected tests to evaluate students' progress in specific areas. The influence of this type of testing on student learning may be as great as or greater than that of large-scale evaluation programs. Addressed below are four types of procedures which, as suggested by Stiggins (1988), are commonly used by teachers. These procedures are formal, informal, dynamic and multiple assessment.

Formal and informal assessment.

There are basically two major ways for a teacher to obtain information that may be useful in instructional planning or in evaluating student progress: formal assessment procedures or informal ones. Formal assessment procedures involve the use of published and/ or standardized tests. These tests are comprised of test items that sample knowledge or skill across a domain but are not specifically related to a single curriculum. Perhaps because they are easy to use, formal tests have been the assessment of choice for large numbers of teachers (Thurlow & Ysseldyke, 1982). However, there are shortcomings in the use of formal assessment devices for instructional planning and evaluation of student progress. First, while standardized tests may be appropriate for prediction purposes or for gaining a normative perspective (Mirkin, Fuch, & Deno, 1982), they do not have high instructional utility in program planning because they actually yield very little useful information about a student's level of skill mastery. Second, formal tests often misrepresent the achievement growth of exceptional children. The standardization population often has not included exceptional students (Salvia & Ysseldyke, 1981), and

formal tests may not be measuring what the teachers has taught (Leinhardt, 1982). So progress evaluations are seldom aided by the results of formal assessment.

Because of the limitations of formal tests, informal assessment procedures are used by teachers as an alternate way of gathering information about pupil performance or as an important supplement to a formal assessment battery. For informal assessments to yield usable information for instructional planning or evaluation of progress, they must be planned carefully, administered systematically, and interpreted precisely. Informal procedures generally focus on student achievement in relation to the demands of the environment and the task instead of to a norm group. As summarized by Bennett (1982), informal assessment allows the teacher to evaluate samples of student behavior in relation to specific instructional concerns; they "teach to the test". Informal procedures are not standardized. They allow for maximal adaptation of administrative procedures, content, materials, and scoring criteria to meet the needs of particular assessment situations. They involve measurement of student performance of everyday tasks in the actual classroom or "natural" setting; they permit teachers to collect data that they could not get with any formal device and to determine the conditions under which the student can perform. Examples of informal procedures would include trial teaching, teacher-made criterion-referenced tests, classroom observations, skill checklists and rating guides, and non-standardized interviews (Bennett, 1982). In sum, informal assessment can provide information about a student's current level of performance, can help define short-term and long-term objectives for a remedial program, can document student progress, and can pinpoint the need for program modifications. The primary advantages of informal assessment lie in the relevance of its findings to instruction and the significant contributions it can make to special education program planning and evaluation. The major disadvantages of informal assessment lie with the demands it makes on

teachers and its unknown technical adequacy (Zigmond & Silverman, 1984) which will be discussed later in this paper.

Dynamic Assessment.

Dynamic assessment is a procedure in which instruction of test-relevant skill is incorporated into the testing session. The investigator-subject interaction is characterized by the teaching of some supposed cognitive prerequisites of learning and problem solving, followed by assessment of the applications of those prerequisites in the solution of further problems (Haywood & Wingenfeld, 1992). Some dynamic assessments have been developed primarily to improve the diagnosis of exceptionality -- in particular, to identify subgroups of mentally disabled students who do benefit from instruction (e.g., Feurstein, 1980). These assessments employ a test-teach-test method. The first test indicates students' starting level. Appropriate strategies for task solution are then taught, with all students receiving identical instructions. The second test measures how much each student benefited from those instructions.

Day and Hall (1987) summarized several advantages resulting from direct measuring of students' responsiveness to instruction. First, dynamic assessments may diagnosis exceptionality more accurately. They may, for example, more clearly distinguish learning-disabled and mildly mentally disabled children. Second, dynamic assessments can provide more precise information about cognitive functioning. Instruction can be directed at specific cognitive skills and the contribution of those skills to improve performance can be assessed. This increased precision can be used to develop more exact profiles of ability and/or disability to guide acceleration and remediation efforts. In addition, these profiles may lead to a better understanding of the observed variability within groups of similarly labelled individuals. Third, dynamic assessments can be conducted with tasks students actually encounter in school. This possibility should enhance the predictive accuracy of the assessment and might yield suggestions on how best to teach school skills. Fourth, dynamic assessments are teaching/learning interactions designed to

improve students' skills. If a student does not benefit from instruction, then the teaching may have been faulty or misdirected. The point is, the problem may reside in the interaction, not in the student. Haywood and Wingenfeld (1992) pointed out that the most significant contribution of a dynamic assessment approach is its accommodation of such questions as, "How can these persons change? What cognitive functions were most amenable to change? What does one have to do to provoke change? How much intervention is required to achieved change? How large or small is the difference between unassisted and assisted performance? What other variables are related to the magnitude of change? What is the response to intervention? What must be done to produce generalization to other areas of cognitive functioning?" (P.255).

Haywood and Wingenfeld (1992) summarized how dynamic assessment can be administered to obtain knowledge that is otherwise elusive. For clinical use of dynamic assessment instruments tend to be tailored to each individual subject's cognitive strengths and deficits. For administration in research, experimenters can develop specific, standardized intervention protocols or allow individualized interaction between investigator and subject that is videotaped and analyzed. For research purposes, the teaching phase is usually followed by one or more posttests administered in a no-help mode. The posttest, usually a parallel, is a near-transfer task that can be followed by a more difficult far-transfer task. In sum, dynamic assessment can be used to obtain knowledge for different purposes, including instructional, clinical and research purposes.

Multiple assessment and the Decision Making Model.

Bachor and Crealock (1986) have developed the decision making model, a multifaceted process designed to reflect a student's continuum of strengths and weaknesses in the awareness and use of strategies. This model advocates the employment of a multiple assessment approach, that is, a number of assessment techniques (e.g., interviewing, observing, and testing) that yield information about strategic behaviour under a variety of conditions. By

following such procedures, a more thorough description of strategy awareness, deployment, and utilization can be obtained. In addition, when all the measures are taken together, the probability of the estimate being accurate increases and the error of measurement decreases.

Strategy Assessment Techniques

Various techniques have been developed to assess cognitive and metacognitive strategies. These include direct observation techniques (Meyers, Pfeffer & Erlbaum, 1985), questionnaire techniques (Schulte & Weinstein, 1981), verbal self-report measures obtained before and after the task (Meyer, Pfeffer, & Erlbaum, 1985), think-aloud procedures (Bereiter & Bird, 1985), and working with the child as a co-investigator (Scardamalia & Bereiter, 1983). Most of these techniques typically involve having students complete an individually assigned task while indicating in some manner the strategies deployed and utilized to complete that task. Proficiency in strategy use is estimated by comparing novices and experts as they complete some tasks (Bachor, 1986). A number of other methods have been used to explore strategic operations, either as alternatives to more traditional interview and think-aloud procedures or as means of generating data for the outcomes of the traditional verbal-report methods. Examples of these specific methods is stimulated recall using videotapes of learning situations to externalize strategic repertoires (Peterson, Swing, Braverman, & Buss, 1982). Some of the more commonly used techniques, which are relevant to this study, are discussed below in more detail. These techniques are interview techniques, think-aloud, and stimulated recall.

Interview.

An early example of an interview study was conducted by Meyers and Paris (1978) to examine metacognitive knowledge about reading. In the study, a standard set of questions about knowledge of interacting person, task, and strategy variables was presented to second- and sixth-grade students. Clear differences in knowledge related to age and experience emerged. The younger children demonstrated far less awareness than the older children of the

existence of various reading strategies and less sensitivity about what, when, and how to use strategies. The studies of Forrest and Waller (1980) and Garner and Kraus (1981-1982) are similar in design and have yielded similar results. All three of these interview studies have produced consistent results of differences in strategic knowledge along the dimensions of age or reading proficiency: older, better readers have more knowledge of cognitive and metacognitive strategies than younger, less able readers. However, on the basis of these interview studies, one cannot say that this superior knowledge is accompanied by superior use of a range of strategies.

Think-aloud.

The most common method employed to investigate strategy deployment is "think-aloud". Think-aloud has the potential to assess strategic learning behaviours used during the actual task, and it has been used frequently for investigations of problem solving skills (Bereiter & Bird, 1985). Think-aloud has been used to assess approaches to solving cognitive problems (e.g., Ericsson & Simon, 1980) and to examine the strategies used to facilitate reading comprehension (e.g., Bereiter & Bird, 1985). A particular approach has been referred to by Lytle (1982) as "think-aloud protocol analysis" which describes what the readers do to facilitate reading comprehension by asking them to think aloud while reading a passage. Lytle has developed a coding system which assesses readers' moves and strategies. She demonstrated that although there are individual differences in patterns of moves and strategies, these patterns are consistent for an individual reader across passages. A critical feature of thinking-aloud protocol analysis is the use of a valid school task such as reading to assess processes. The use of school tasks increases the potential for appropriate recommendations for interventions resulting from assessment. For further discussion of think-aloud, please refer to the section on problems with assessment methods in this Chapter.

Stimulated recall.

Peterson and her colleagues (1982) used a stimulated-recall technique to study students' cognitive processes during a teaching-learning segment. Student behavior during the lessons was coded by three observers; all lessons were videotaped as well. Following each lesson, students were interviewed individually using the stimulated-recall procedure. Interviews were audiotaped.

Students were asked questions about what they were doing or thinking at five different times of the videotape of the lessons. Interviewers were given specific prompts. Trained coders coded interview protocols for later analysis. The stimulated-recall technique was employed to uncover covert cognitive processes not observable by either on-site coders or videotape viewers.

Student interview responses were coded into five major categories: (a) attending; (b) understanding; (c) reasons for not understanding; (d) cognitive strategies; and (e) teaching processes. A number of findings emerged. First, observed off-task behavior was unrelated to students' report of attending to the lessons. Second, students who reported comprehending all of the materials tended to perform well both on assigned seatwork and on the achievement test. Third, students who did not provide detailed explanations of comprehension problems tended to do poorly on seatwork and on the achievement test. Fourth, a broad range of general and specific strategies (e.g., reworking a problem, reading/rereading directions, asking for help) was reported. A strategy labelled "trying to understand the teacher or problem" that involved general problem-solving steps applied to the particular task and materials was significantly positively related to both seatwork and achievement test performance.

Peterson and her colleagues (1982) pointed out that the stimulated-recall method avoided some of the problems associated with traditional interview techniques. Most important in this regard, the viewing of the videotaped record of the lesson in this study was a "nondirective retrieval cue that served to enhance the veridicality of the reports" (p.546). Though verbal facility remained

a potential confounding factor, memory failure, hypothetical questions, and overcueing were arguably diminished in impact.

Issues in Cognitive and Metacognitive Strategy Assessment

The issues in cognitive and metacognitive strategy assessment can be categorized into four general types: problems with basic assumptions of cognitive psychological models, problems with what to assess, problems with assessment methods, and problems with research methods.

Problems with basic assumptions of cognitive psychological models.

Siegler (1989) indicated that even seemingly well-documented cognitive psychological models may be drastically incorrect, and that diagnoses of individuals based on these models could only be equally incorrect. He also argued that cognitive analyses have the potential to yield diagnoses that go beyond those possible with standard psychometric techniques. He therefore recommended that the assessment tools should be validated until we are confident that they will improve educational practice, and only then they will be implemented in classroom.

Problems with what and how to assess.

1. Assess domain-specific or content free strategies -- There is a considerable debate as to whether task-specific or content-free strategies are more effective in the instructional situations (Pressley, 1987; Sternberg, 1984) and subsequently which type of strategies to assess. These two different types of strategies are offered consistently as explanations of children's and adolescents' cognitive learning strategies. Identification and training of effective task-specific strategies is the first focus. For example, a number of text comprehension strategies and "backtracking" have been identified as differentiating between good and poor readers (Meyer, Brandt, & Blutch, 1980). Similarly, effective strategies have been identified in learning and problem solving in specific subject matters, such as mathematics (e.g., Hiebert & Wearne, 1986; Kintsch & Greeno, 1985). General, content-free strategies that may be used across tasks or subject matter domains have been the second

common approach to learning strategy research (Derry & Murphy, 1986; Mulcahy & Marfo, 1987; Sternberg, 1984). The goal in this case is to identify task demands and to implement content or task-specific strategies as required.

2. Include noncognitive aspects of learning -- In addition to assessing domain-specific or content-free strategies, Snow (1989) stressed the importance of developing approaches to assessment that take into account noncognitive and nonverbal aspects of learning as well as individual differences in learning styles. Examples of noncognitive aspects of learning are deep understanding, higher order skills, strategic flexibility, and adaptive control.

3. Reveal varieties of strategies -- Citing data that reveal that students often use a variety of strategies to perform a given cognitive task, Siegler (1989) argued the importance of developing assessment techniques that would reveal these strategy varieties and thereby yield an understanding of cognitive performance and appropriate instructional programs. He demonstrated how cognitive models based on chrometric analyses of aggregate data could obscure individual differences in strategy use and yield misleading diagnoses of individual performance. He saw promise in the use of videotaped documentation of the performance of cognitive tasks and retrospective verbal reports immediately following task completion as effective sources of information regarding strategy use.

4. Use systemically valid tests -- A systemically valid test, in Frederiken and Collins's words (1989), is one that induces changes that foster the development of the skills the test is designed to measure. They argued that the way to ensure systematic validity is to design tests that directly measure cognitive abilities that are the targets of instruction. Systemically valid tests would be accurate representations of what students should be attempting to learn and could serve as standards of desired performance; rather than subverting educational purposes, instruction and study aimed explicitly at mastering the test demands would be fulfilling.

Problems with assessment methods.

1. Multiple-choice or single-right-answer items -- Tests that are to be widely used have to be easily administered and easily and unambiguously scored. These constraints have usually been translated operationally into multi-choice or other highly structured formats and single-right-answer items. As Frederiken (1984) has pointed out, the problems with which people have to deal in everyday life often are not well structured and do not have a single correct solution. Relative to the testing of thinking, a major problem with multiple-choice tests is their failure to give evidence of the nature of the reasoning process by which choices are made. Not only is it possible sometimes to get the right answer for inappropriate reasons, but it is also possible sometimes to arrive at the wrong answer via a well-reasoned path, especially if the test taker brings to the situation background knowledge or beliefs not anticipated by the test maker.

While recognizing the limitations of multiple-choice tests, Norris (1989) points out that, given their popularity and economic attractiveness, it is worth considering whether they can be used effectively to test for at least some aspects of thinking. Kneedler (1985) also has argued that it is possible to do more with objective tests than to test for fact recall. Inasmuch as a major limitation of multiple-choice critical-thinking tests stems from the strong possibility that examinees' responses to items can depend in part on beliefs that are independent of their critical-thinking abilities, Norris (1989) sees some promise in the possibility of combining multiple-choice testing with respective justifications of answers, think-aloud protocols, or other means of probing the bases for answer selection. The use of introspective reports seems appropriate, he argues, because the thinking behind answer selection is of greater interest in a test of critical thinking than the answer selected, and because experimental evidence supports the view that the examinee's thinking is not affected by the process of reporting. Norris (1989) proposes a procedure for developing an objective test of credibility judgement, which

involves collecting verbal reports of test takers' thinking while answering test items, scoring these verbal reports, correlating these scores with scores on the objective test, item by item; and revising the test by replacing items that could be answered correctly for wrong reasons or incorrectly in spite of good reasoning. He cautions that the approach has limitations and needs to be tested.

2. Verbal report as data -- Both interviews and think-aloud procedures can be classified as "verbal-report methods" in that learners tell receptive listeners (typically researchers) what they have on occasion thought and done, what they might think and do in a hypothetical situation, or what they are thinking and doing while completing a task at hand. Interviews produce retrospective verbalizations, for they elicit reports of cognitive and metacognitive activity already completed. Think-aloud procedures produce concurrent verbalization about an activity that is temporarily interrupted for provision of the verbal report.

Both interviews and think-aloud procedures have encountered criticisms on a number of fronts. Perhaps the most basic concern is the accessibility of cognitive and metacognitive processes for introspective analysis. As Nisbett and Wilson (1977) put it, one can "doubt people's ability to observe directly the workings of their own minds" (p.232). One may have the experience of generating relatively vague, inarticulate descriptions of processing, when called upon to produce them unexpectedly.

The second major concern is when recurrent processes become automated and routinized, they also become less reported (Ericsson & Simon, 1980). The result is incomplete data, and potentially inappropriate inferences about strategic processing. Meichenbaum (1980) suggests, in this regard, to always treat protocols as incomplete records of thinking, and to avoid the error of equating language with thought.

Another concern is verbal facility. When verbal-report data are collected from individuals with limited language skill, such as young children or mentally

retarded children, verbalizing difficulties can mask strategic strengths (Cavanaugh & Perlmutter, 1982). Related to developmentally young children's nonproficiency in verbalizing is their inexperience in responding to highly general questions or probes (Yussen, Mathews, & Hienert, 1982). They are likely to respond to questions about cognition with information about just-experienced events. These children may need to be given specific strategic activities to which they can react with some reverential certainty (Garner, 1988). Considerable individual differences in the tendency to verbalize also exist (Garner, 1988). Because verbal skills are not adequately developed in some learner groups, some nonverbal assessment of cognitive and metacognitive strategic knowledge may be in order. Yussen and Bird (1979), for instance, have presented pictorial, rather than verbal, stimuli to children.

Nisbett and Wilson (1977) pointed out that learners, such as young children, not only sometimes know more than they can tell, but they on occasion tell more than they can know. That is, they report what they perceive they ought to know or do, what they think ideal thinkers know and do, not what they in fact know or do. As Ericsson and Simon (1980) point out, in cases such as these, verbal reports may bear very little relation to actual processes.

Simon (1979) identified the concern regarding the probes and cueing offered by instructions. Information about the social desirability of particular strategies can be conveyed by inadequately bland statements. An investigator can ask about the use of a specific strategy, encouraging learners to respond affirmatively. The investigator, in other words, can provide a broad hint of the most desirable response. Again, the resulting verbal reports from subjects may bear only minimal relation to their actual strategic processing.

Cavanaugh and Perlmutter (1982) pointed out that very few researchers examine the stability of verbal responses over time. This means that potentially unstable patterns of reporting are not discovered as such, and far-reaching interpretations of strategic activity may be too hastily drawn.

Two additional concerns pertain only to interview methods. One is that a large processing-reporting distance (i.e., a long time lapse between thinking/ doing and providing the verbal report of what was thought and done) allows memory failure to intrude as an explanation for skimpy reporting (White, 1980). As White suggests, much more may have been consciously processed than is present in the verbal-report record. The second concern is that interview methods often elicit responses to hypothetical situations that are difficult for young children to interpret. That is to say, no strategic activity is engaged, but reporting on potential activity is elicited. As Ericsson and Simon (1980) argue, probing for hypothetical states cannot tap learners' memories for their cognitive and metacognitive processes, for the information was never in memory.

Various critics have addressed the negative effect of disrupting cognitive or metacognitive processes to generate the verbal report. To minimize disruption, infrequent interruptions and unobtrusive introspection methods are usually advocated (Kellogg, 1982). Critics maintain that the process can still be broken down "into unrepresentative meaningless fragments " (Fischer & Mandl, 1982, p.344) by the interruptions. This is a distinct possibility for research studies that include breaks after every clause of a short story. Certainly, an agile reader might want to finish the story to eliminate the interfering. A possible outcome is depressed verbalizing and, therefore, incomplete reporting of cognitive and metacognitive activity. As Cavanaugh and Perlmutter (1982) suggested, the verbal reports in these cases can be both quantitatively and qualitatively poor reflections of processing.

In order to overcome some of the problems with verbal reports, a number of guidelines have been suggested by Ericsson and Simon (1980):

(a) Tap information available in short-term memory; responses will be more accurate and will not drastically diminish processing capacity. In this regard, reduce strategy use-strategy report intervals, and ask learners to report on specific events, not on hypothetical situations. Avoid automated processes; by definition, conscious attention is not necessary for their activation.

(b) Ask learners what they do and think, not why. The amount of interference required is thus constrained.

(c) Recognize that some verbal reports may be incomplete, but may still contain useful information. Prompt full reporting in a noncueing fashion, and with minimal process disruption.

(d) Consider methods that reduce verbalization demands, particularly in gathering information from young children.

(e) Assess reliability of responses.

(f) Use multimethod assessment. By using a set of different methods that do not share the same sources of error, researchers eventually collect convergent data on actual strategies used by learners. Observable nonverbal behaviors (e.g., eye movements) are an excellent companion database (see Flavell, 1981), particularly for work with young children. Combining verbal-report data on process with product data (e.g., underlined protocols, written summaries of text) is another useful approach (Alexander, Hare, & Garmer, 1984).

The sixth guideline perhaps demands the most emphasis. As Kail and Bisanz (1982) put it, "no single approach is sufficient for unambiguous and comprehensive identification of a person's cognitive strategies" (p.252).

Problems with research method.

1. Reliability and validity of assessment instruments -- Most of the assessment procedures and techniques discussed in this chapter are informal in a sense that they are not standardized. The major disadvantage of informal assessment instruments lies with their unknown technical adequacy. The most serious limitation in the use of informal assessment procedures concerns reliability. Usually no information is available concerning the quality (i.e., reliability and validity) of these informal tests (Zigmond & Silverman, 1984). To increase the technical adequacy of informal procedures, Bennett (1982, p.338-339) suggested that teachers: (a) specify the purpose of the assessment; (b) construct/select assessment procedures so that they are relevant to the

purpose of assessment; (c) define precisely the domains to be assessed or the objectives to be evaluated; (d) select assessment tasks so that they are representative of the domain or tied to the objective of interest; (e) specify the dimensions on which performance will be judged and the criteria for determining a correct response; (f) specify the criteria for evaluating overall performance and the rationale for selecting those criteria; (g) use as lengthy an assessment as possible.

2. Assessment accuracy -- A major difficulty facing researchers and applied professionals who are interested in strategy instruction is assessment accuracy. Bachor (1991) points out that if one administers a series of tasks with the intention of establishing strategic behavior, to some lesser or greater extent, such performance must be inferred. Further, any observed strategic behavior is only a sample of what might have been obtained. As a result, assessment always requires inference and is subject to error. There are at least two potential errors that influence the accuracy of any procedure designed to estimate cognitive and metacognitive processes. First, there is the error of measurement that accompanies obtaining a time-bound sample. Gathering such data provides only an estimate of what a person did, not what he or she may have done on different occasions. Second, there is the error associated with administering each instrument or procedure selected to obtain an estimate of strategic behavior. No single procedure, regardless of the attractiveness of the assessment technique, can stand alone. In sum, the application of all assessment techniques, regardless of validity, can never result in more than a situation-specific estimate of a student's thinking skill performance pattern. He therefore recommends the use of a multiple assessment procedure.

3. Domains of strategies not distinctively defined -- Various attempts have been made to identify, isolate, and measure a number of different cognitive strategies. Gagne and Beard (1978) point out that in many instances, the items of strategy assessment tools require the application of rules and the recall of information, in addition to the use of cognitive strategies. Thus, the

measures provided are not distinctive, in that it is not clear which learning outcomes are assessed. Consequently, it cannot be said that distinctively defined domains of cognitive strategies have been achieved.

Norris (1989) noted that the problem of assessing thinking processes is complicated by the vagueness of such processes, by the lack of objective standards against which to judge thinking quality, by the ongoing dispute over the extent to which there are standards or principles of thinking that apply independently of the knowledge domain to which the thinking pertains, by the difficulty of distinguishing between the roles of critical-thinking ability and subject-specific knowledge in particular instances, and by the inscrutability of the motivations, beliefs, or intentions that underlie behavior. He also pointed out it is not yet clear how to assess critical-thinking dispositions or to test for critical thinking in the context of real-world problems, which requires the orchestration of a variety of abilities and dispositions and the weighing and balancing of conflicting principles and standards.

Conclusion

To summarize, the literature suggests that different informal assessment procedures and techniques can be used by teachers to assess cognitive strategies. There are problems associated with these procedures and techniques and researchers have suggested solutions to some of the problems. To conclude, it is important to make a strong statement in favour of using dynamic assessment and multiple assessment procedures to assess cognitive and metacognitive processes. Data should be collected from many sources and in different conditions. Different assessment techniques such as think-aloud, tape-recording, observing, and testing can be used. In this manner, we can be more certain of our conclusions because the different sets of data are not vulnerable to the same sources of invalidity. As well, the important goal of identification of subjects' strategic repertoires is achieved with less ambiguity than if any single method were applied.

Chronological Age (CA) Matching Versus Mental Age (MA) Matching in Research

This study addressed the differences between mildly mentally disabled subjects and average intelligence subjects in memory strategy, attributions and learning behaviors. Literature indicated that some researchers, when conducting comparative studies of these two groups, were in favour of Chronological Age (CA) matching whereas others supported the use of a Mental Age (MA) matching procedure. Some of their considerations are discussed below.

Chronological Age Matching

Ellis (1969) is in favour of CA matching because it is "directed at the primary characteristic of mental retardation ... the difference in adaptive behavior of persons of similar chronological age that define mental retardation" (p.563). The rationale implied in such matching is that the individuals may differ in genetic endowment, central nervous system dysfunction, or any combination of these factors interacting with the environment over a maturation period. Therefore, if one can be certain that the above factors did not interfere with an individual's maturation, then environmentally produced maturation or retardation may be studied in equal CA designs. The differences found under these conditions could then be attributed to the developmental interaction between the organism and the environment. However, some would argue that the behavioral differences in the extremes are so great that comparisons based on the CA dimension can not be fully justified (Weisz, 1976). Other investigators (Harter 1967, Zeaman & House, 1967) have not considered CA as a relevant dimension or variable, while at the same time reporting MA and IQ as correlates of visual discriminating learning in comparative studies. Zeaman and House (1967) reported that with either MA or IQ held constant, "the other (MA or IQ) still correlates significantly with learning, thus establishing the independent relation of both MA and IQ to learning ability" (p.57). In the discrimination learning set formation study on disabled and non-disabled subjects, Harter

(1965) concluded, "in view of the negligible relationship obtained between learning set and CA, one may conclude that CA is neither a contributing nor a contaminating factor, and that interpretations based solely on IQ and MA are justifiable" (p.40).

In a discussion of problems in comparative cognitive research on disabled and non-disabled persons, Baumeister (1967) pointed out that the experimenter may be unable to meaningfully measure equal CA normals and retardates under the same conditions because the differences are more pronounced at both extremes. In a critique on the analysis of CA, MA, and IQ effects in comparative studies, Kappauf (1973, 1976) suggested that the MA x IQ design may be useful in interpreting comparative cognitive studies.

Mental Age Matching

The rationale underlining an equal MA research design is that an MA-match equalizes the developmental level of disabled and non-disabled populations in comparative cognitive research (Weisz, 1977). MA is based on achievement which is believed to be the product of complex interactions of motivation and experience over a developmental period (Ellis, 1969). Thus, MA may reflect past and present motivational as well as cognitive factors.

The research literature presents a broad mix of studies comparing disabled and non-disabled individuals. For example, Estes (1970) suggested that quantitative differences in rates of learning tend to disappear when MA is equated. In discussing the implications for the analysis of CA, MA and IQ effects, Kappauf (1973) observed that an MA effect must be present in the data if performance improves with IQ.

The Necessity for Comparative Studies

The rationale implied in comparative studies is that the behavior of disabled individuals can be better understood in relation to a normal baseline. Such an understanding of disabled behavior can be obtained when compared to normal individuals' performance under comparable conditions. Chronological age matching appears to pose several problems because CA, to

date, has not been found to account fully for the acquisition of cognitive abilities that are required in learning and performance of the disabled.

It must be noted, however, that there are similarly several problems associated with an MA match. As Sattler (1988) pointed out, two individuals may arrive at a similar MA for entirely different abilities. In the case of normal and disabled individuals, it is conceivable that there are qualitative as well as quantitative differences in the structure of abilities. As a result of these factors, an experimenter may, unknowingly, constitute a group on the basis of MA highly related to the criterion measure. If such is the case, it may be possible to find differences in performance between groups even though they are matched on equal MA. Other factors such as school experience, reinforcement history, physical and motor impairments, institutionalization, socio-economic status, comprehension of instructions, to mention a few factors, may interfere with the performance of able as well as disabled persons.

Researchers have attempted to minimize these factors through procedures such as randomization, selection of subjects without any known physical impairments, obtaining disabled samples from special schools where success experiences are compared to the disabled from regular classrooms. Absolute control seems impossible and researchers must be aware of these limitations.

The research review presented in this section on matching samples seems to suggest that MA-match is favoured by several researchers (Weisz, 1977) since MA is believed to equalize the developmental level of disabled and non-disabled individuals. In conclusion, it seems useful to point out that many researchers may continue to use MA-match in comparative cognitive research "until a more refined index is constituted as a measure of general cognitive level" (Zigler, 1969, P.534). In view of the above discussion, it would seem appropriate to study the similarities and differences of MA-matched disabled and non-disabled subjects in memory behavior.

Specific Problems Presented in the Literature

The literature reviewed suggests that memory strategy interventions help to remediate memory, knowledge base and strategic behavior deficits of children with mental disabilities. Some of the memory strategies useful for these children are rehearsal, visual imagery and mnemonic devices. When teachers assess these children in the classroom for diagnostic and remediation purposes, dynamic assessment procedures, multiple assessment procedures and ecologically relevant tasks should be adopted.

However, there are some problems in the research literature in the area of memory strategy assessment. First, the availability of entry-level strategies in the individuals' repertoire have not been carefully taken into account. It would be essential to consider individual differences, at the initial stage of training, in knowledge base with respect to the specific strategies for successful memory strategy training. Second, research on memory strategy assessment with MMD adolescents using dynamic assessment procedures is limited. Third, research on multiple assessments with ecologically relevant tasks for use by teachers is limited. If the assessment is to be ecologically relevant and useful for diagnostic and remediation purposes, the feasibility of using different assessment procedures with ecologically relevant tasks should be explored.

Considering the problems presented in the literature, the present study will explore the feasibility of using different assessment procedures (e.g., informal assessment, multiple assessment and dynamic assessment procedures) in the classroom to assess MMD subjects' entry-level memory strategies. The assessment techniques will include the think-aloud procedure, observations by teachers on subjects' memory strategies, subjects' verbal descriptions of their strategies, and investigator assessment on subjects' actual performance on tasks. The tasks designed are related to curriculum content and are meant to be used by classroom teachers as the first step of the dynamic assessment procedures. According to the assessment results obtained, teachers at a later stage may follow other steps of the dynamic

assessment procedures such as deciding which memory strategies to teach, and which instructional methods to use.

CHAPTER III

METHOD

Introduction

As presented in Chapter One, the main purpose of the present study was to explore the initial state of memory strategies, attributional beliefs, and learning behaviors of adolescents with mild mental disabilities. The feasibility of implementing multiple assessments (teachers' observations, subjects' self-reports and investigator's assessment) and ecologically relevant tasks to measure this initial state was also investigated.

Within this chapter, the design of the study is reviewed. To provide an overview, this chapter begins with listing the general procedures for the study. The Pilot Study conducted prior to data collection is summarized, and subsequent procedural modifications are outlined. The subjects for the main study and the setting are described. A description of the instruments used in the study and the methods employed in the collection of data follows. The chapter concludes with a description of the methods adopted in the analysis of the data.

General Procedures

1. A pilot study was first conducted with six students from two schools to test the feasibility of the actual investigation, the ecological relevance of the tasks, and the appropriateness of the administrative procedures for the tasks. Based on the results of the pilot study, the tasks and the procedures were subsequently revised.

2. To carry out the actual investigation, subjects from the school assigned by the Catholic School Board were selected based on the selection criteria described in the Main Study section. To ensure that all the subjects met the selection criteria, background information on each individual subject was collected from the school and entered in the Subject Background Information Form (see Appendix A) by the investigator.

3. Meetings with classroom teachers of the subjects were arranged to provide and explain relevant information with respect to the study. An information sheet on the purposes, subject selection criteria, procedures, research questions and implications of the study was given to each teacher. Copies of the parental permission letter which also described the purpose, procedures and the significance of the study were provided for the teachers to obtain consent from parents of the potential subjects.

4. The teachers were then requested to observe the subjects on different occasions and complete Instrument No. 1: Teacher Questionnaire on Memory Strategy (see Appendix B) for each individual subject.

5. The subjects were individually trained by the investigator in the think-aloud procedures. The procedures and instructions for the training in think-aloud are outlined in Appendix E.

6. The subjects were then individually interviewed by the investigator and were required to respond to the memory tasks in Instrument No. 2: Subject Self-Report on Memory Strategy (see Appendix C). The subjects had to think-aloud and verbalize their solutions to the tasks without actually performing them. Their verbal reports were tape-recorded for later analysis.

7. Subjects were tested individually again by the investigator with Instrument No. 3: Investigator Assessment on Memory Strategy (see Appendix D) which required them to think-aloud their memory strategies while performing the memory tasks. Their verbal reports were tape-recorded for later analysis.

8. The investigator interviewed the teachers to obtain additional information and to verify results from administering the Instruments.

Pilot Study

A pilot study was conducted in May and June, 1992. The purposes of the Pilot Study were to obtain some preliminary information regarding the feasibility of the actual investigation, the suitability of the tasks for memory strategy assessment, the ecological relevance of the memory tasks, and the

appropriateness of the administrative procedures. The age levels, subject selection criteria, instruments, memory tasks, administration procedures, data collection and scoring techniques were those which would be involved in a full scale study.

Subjects in the Pilot Study

The subjects for the pilot study consisted of six students from four classes in two schools in the Catholic School System in Edmonton, Alberta. Three students with mild mental disabilities (2 males and 1 female) and three grade 4 students with average intelligence (2 males and 1 female) who met the selection criteria were nominated by the schools concerned. The students with mild mental disabilities attended special education classes in a regular school. The mean full scale IQ score of the MMD group was 64.7 and the range was 60 to 68. The mean CCAT verbal score of the AI group was 96 with a range of 95 to 97. The mean CCAT non-verbal score for the AI group was 98.7 with a range of 87 to 110. The mean chronological age of the MMD group was 175.3 months and the range was 168 months to 180 months. The mean chronological age of the AI group was 114.7 months and the range was 112 months to 118 months. Regarding the ethnic background, all the six subjects were born in Canada. One subject in the MMD group and one subject in the AI group had a home language which was not English.

Instruments

The Pilot Study used all three instruments which were to be administered in the actual investigation. These instruments are outlined in the General Procedure section and discussed in more detail in the Instruments section in this chapter.

While administering and scoring these three instruments, the investigator followed very closely the procedures to be used in the actual investigation.

Procedures

All six subjects were individually interviewed and their personal information was entered on the Subject Background Information Form (see

Appendix A). Their classroom teachers observed them for some time on a few occasions and completed Instrument No. 1. After the subjects were trained in the think-aloud procedures, they were presented with the tasks in Instrument No. 2 and Instrument No. 3 respectively by the investigator. Individual responses were tape-recorded for later analysis. The six subjects and the four teachers involved were interviewed with respect to their views and comments on Instruments No. 2 and No. 3.

Results of the Pilot Study

Results of teachers' perceptions and prediction, subjects' self-reports, and investigator's assessment indicated that both AI and the MMD groups were aware of and used memory strategies. The AI group reported using all four strategies this study is concerned with: maintenance rehearsal, elaborative rehearsal, visual imagery and mnemonics. The mnemonics they reported using were first-letter mnemonics, key-word, and loci. In addition to the memory strategies, they also applied other regulatory strategies to help them remember the tasks. Examples of such strategies were checking, obtaining help from others, and performing the task immediately so that they would not forget. The MMD group had a lower frequency and smaller range of memory strategies than the AI group. The MMD group indicated using mostly maintenance rehearsal and visual imagery. The other regulatory strategies they reported using were similar to those indicated by the AI group. However, a comparison between the AI and the MMD group in the Pilot Study could not be generalized to other situations because two AI subjects were taught cognitive strategies by their class teacher with S.P.E.L.T. (Mulcahy, 1986). As a result, the overall performance of the AI group in memory tasks was much better than the MMD group.

Results with respect to suitability of tasks, ecological relevance of tasks and administrative procedures are discussed below.

Comments on the Instruments and Tasks

Comments from the subjects.

Following the administration of the tasks in Instrument No. 2 and Instrument No. 3, each subject was interviewed regarding his/her opinions on the instruments such as the interest level of the tasks and the familiarity with the topic.

All six subjects indicated that the tasks in Instrument No. 2 were within their level of understanding and that the directions were clear. They agreed that the topic Disneyland for Instrument No. 3 was relevant. They were aware of Disneyland through watching television and they were interested to know more about Disneyland. They indicated that Instrument No. 3 was more interesting than instrument No. 2 because with the former Instrument, they could actually apply memory strategies to perform the tasks. With Instrument No. 2, they could only describe the memory strategies they might use without actually performing the tasks. The subjects with mild mental disabilities considered some reading passages were too difficult for them.

Comments from the teachers.

Discussions with the four teachers in the two schools were carried out. The following suggestions were put forth by the teachers:

1. The reading level of the passage should be lowered and should be within a Grade 2 level for subjects with mild mental disabilities. The passages were subsequently revised. The teachers agreed to the appropriateness of the vocabulary and the reading level of the revised passages.

2. The topic Disneyland adopted in Instrument No. 3 was considered by the teachers as appropriate because all the subjects had some degree of knowledge and interest in Disneyland but they did not know the details well. The tasks therefore could reflect their use of memory strategies to remember the information provided by the investigator rather than the subjects' previous knowledge and experience in the topic. The teachers suggested that some

topics like hockey, and popular singers might be more interesting for the subjects. However, as the subjects usually had a good knowledge of these topics, appropriate responses given by the students could reflect their knowledge base in the topics rather than the memory strategies they would utilize to memorize the tasks.

3. Most of the tasks in the two instruments were relevant to the curriculum in the schools concerned. Some suggestions were made to improve the ecological relevance of the tasks. Examples of such suggestions were to include tasks on following a recipe and categorizing food items.

4. In one of the schools, learning strategies were previously taught by a teacher to the subjects in the average intelligence group. As a result, the performance of these subjects on memory tasks was much better than the other groups. This school was therefore dropped from the actual study.

Summary

On the basis of the results of the Pilot Study, the investigator made some relevant modifications. These modifications involved task revision, clarification of the procedures to be utilized, standardization of instructions, and simplification of the language level of the tasks (see Appendices for the final version of instruments used in the main study). As well, an average time allotment of one-hour per student per instrument (Instruments No. 2 and No. 3) was estimated although no time limit was actually imposed. In the actual investigation, the subjects were encouraged to study or give the responses whenever they reported that they were ready.

The Main Study

The Subjects

Selection criteria.

The Main Study comprised two groups of subjects: a Mildly Mentally Disabled group (MMD) and an Average Intelligence group (AI). Three criteria were considered with respect to the selection of the subjects in each group.

The criteria were intellectual level, age, and the absence of any outstanding deficits that might interfere with the progress of the study.

1. Intellectual level criteria -- The subjects in the MMD group were specified as those having an intelligence quotient in the range of 60-75 on the Wechsler Intelligence Scale for Children-Revised (WISC-R), which was administered by the School Board. The average standard error of measurement in IQ points is 3.19 for the WISC-R Full Scale. The intellectual level of the AI group was estimated on the basis of their Canadian Cognitive Ability Test (CCAT) verbal and non-verbal scores administered by the school. The subjects in the AI group were specified as those having their CCAT verbal and non-verbal scores within one standard deviation above or below the mean. The absence of learning difficulties was reported by the teachers and supported by having their general achievement levels within one standard deviation above and below the mean on Canadian Tests of Basic Skills (CTBS) administered by the school.

2. Age criteria -- The MMD Group was within the chronological age range of 168 months (14 years) to 180 months (15 years), plus or minus four months. Their mental age was estimated to be in the range of 101 months (8 years 5 months) to 135 months (11 years 3 months). The AI Group consisted of subjects with average intelligence whose chronological age matched the mental age of the MMD group. Their chronological age should therefore be within the range of 101 months to 135 months, plus or minus four months. Selection of this particular age group for this study was based upon Piaget's formulation of stages of cognitive development. Children between the mental ages of seven and eleven years are generally considered to be at a concrete operational level during which time the ability to classify becomes operative. At a later age or stage, the period of formal operations is marked by an extension of cognitive abilities. Thus children within the age range selected for this study were assumed to be operating at a concrete operational level and therefore they should be able to classify, and use maintenance rehearsal, elaborative

rehearsal, visual imagery and mnemonics strategies.

3. Absence of outstanding deficits criteria -- Both groups of subjects did not have any outstanding physical, sensory, behavioral, language, attention or cultural deficits that might interfere with the progress of the study.

Selection of subjects.

The above criteria for selection of subjects were discussed with the principal and teachers of the school concerned. Subsequently the teachers recommended a list of 27 students (15 for the AI group and 12 for the MMD group) who might meet the criteria. Initial screening by the investigator, in consultation with the teachers concerned, was conducted. Pertinent information such as achievement test results, chronological age, the most recent IQ scores or CCAT scores for each of the students on the recommended list were obtained from the teachers and from the cumulative record cards in the school. The intellectual level of the average intelligence sample were estimated on the basis of their CCAT results at school. The mental age of the mildly mentally disabled sample was estimated on the basis of their full scale IQ scores. The absence of any major learning problems of the subjects was confirmed and verified by their teachers. Students who did not meet the criteria or who were suspected of having language or verbal fluency difficulties to perform the tasks in this study were exempted from the pool of the sample. As a result, twenty students, ten in each group, were initially included in the study. However, one subject from the MMD Group was dropped from the sample towards the end of the study because he was absent from school for a long period of time and did not complete the tasks in Instrument No. 3.

Description of the subjects.

A summary of information on the subjects is discussed below and presented in Table 1 and Table 2.

1. Intellectual Level -- The mean full scale IQ score of the MMD Group was 68.8 and the range was 60 to 76. Three subjects in this group did not have a record of their verbal and performance scores available in the

school. For the other six subjects, the mean verbal score was 68.3 with a range of 57 to 81. The mean performance score for these six subjects was 67.5 with a range of 64 to 74. The mean mental age of the MMD Group, based on the full scale IQ scores on WISC-R, was 120 months with a range of 104 months to 139 months. The mental ages were calculated by using the formula: iQ = MA/CA x 100. The intellectual level of the AI sample was estimated on the basis of the CCAT scores. The mean CCAT verbal scale score of the AI Group was 96.8 with a range of 91 to 108. The mean CCAT non-verbal scale score for the AI group was 99.2 with a range of 87 to 109. The IQ data and CCAT scores obtained from the school records has been described in Table 2. It was not possible to use statistical methods to compare the IQ scores for the MMD Group and the CCAT scores for the AI Group of subjects participating in this study. Statistical comparison could not be made because the IQ scores of the AI subjects had been derived from CCAT which is a group test, while those of the MMD Group had been derived from WISC-R which is an individual intelligence test.

2. Chronological Age -- The mean chronological age of the MMD Group was 174.7 months and the range was 164 months to 184 months. The mean chronological age of the AI Group was 114.5 months and the range was 105 months to 133 months. The information on the ages of the two groups is in Table 2.

3. Gender -- The gender of the subjects in the two groups was not matched. There were six female subjects and three male subjects in the MMD Group, nine female subjects and one male subject in the AI Group.

4. Ethnic Background -- Regarding the ethnic background, all except three subjects were born in Canada. Two of the three subjects who were born outside Canada moved to Canada when they were six-years-old. One subject moved to Canada when she was one-year-old. However, three subjects in the MMD Group and seven subjects in the AI Group had a home language which was not English. This study accepted a large number of subjects whose home

language was not English for two reasons. First, second language students are typical in inner city. Second, due to the changes in immigration policy, there will be an increased number of immigrant children moving into Canada whose home language may not be English. The diverse ethnic background of students will become common in Canadian schools.

The Setting

The subjects included in the present study were students from one inner city school in Edmonton, Alberta. This school was assigned to the study by the Catholic Schools System and was included as one of the schools in the Pilot Study.

The community served by the school was somewhat typical within the inner city region with regard to socioeconomic status. According to the information obtained from the school, most of the students come from lower social economical status with quite a large number of students who have English as a second language. In the school, English as a Second Language instruction is provided from Early Childhood to grade 9.

The school serves 525 students. It operates sixteen regular program classes and a Polish program from pre-school level to grade 9. It also offers two educational experience program classes for thirty students with mild mental disabilities. The educational experience program strives to accomplish the following objectives: to develop academic skills, to develop social skills and to develop occupational skills. The students have basic subjects such as language arts, mathematics, social studies, health science and life skills in the home classroom. They are integrated with other students in the school during music, home economics and physical education classes. The students are also socially integrated with other students during recesses and other school functions.

TABLE 1

Background Information on Subjects
(N: AI=10, MMD=9)

Subject	Gender	Nationality	Home Language	Birth Place
Average Intelligence Group (AI)				
No. 1	Female	Chinese	Chinese	Canada
No. 2	Female	Indian	Punjabi	India
No. 3	Female	Philippino	English	Canada
No. 4	Female	Chinese	Chinese	Canada
No. 5	Female	Cambodian	Thai	Canada
No. 6	Female	Cambodian	Cambodian	Canada
No. 7	Female	Italian/Polish	Dutch	Canada
No. 8	Female	Canadian	English	Canada
No. 9	Male	Philippino	Tagalog	Philippines
No.10	Female	Canadian	English	Canada
Mildly Mentally Disabled Group (MMD)				
No.11	Female	Canadian	English	Canada
No.12	Female	Canadian	English	Canada
No.13	Male	Italian	Italian	Canada
No.14	Female	Canadian	English	Canada
No.15	Female	Hawaiian	Hawaiian	Hawaii
No.16	Male	Canadian	English	Canada
No.17	Male	Canadian	English	Canada
No.18	Female	Portuguese	Portuguese	Canada
No.19	Female	Canadian	English	Canada

TABLE 2

Description of Subjects: Ages, IQ and CCAT Results
(N: AI=10, MMD=9)

Subject	C.A. (Month)	IQ	M.A. (Month)	CCAT *V	*N
Average Intelligence Group (AI)					
No. 1	107	--	--	108	106
No. 2	111	--	--	106	105
No. 3	105	--	--	97	100
No. 4	106	--	--	100	95
No. 5	116	--	--	91	109
No. 6	114	--	--	85	90
No. 7	105	--	--	95	87
No. 8	133	--	--	85	92
No. 9	123	--	--	105	109
No.10	125	--	--	96	99
MEAN	**114.5**	**--**	**--**	**96.8**	**99.2**

Subject	C.A. (Month)	IQ *V	*P	*F	M.A. (Month)	CCAT *V	*N
Mildly Mentally Disabled Group (MMD)							
No.11	164	66	64	66	108	--	--
No.12	164	68	69	64	104	--	--
No.13	177	--	--	65	115	--	--
No.14	173	81	74	76	131	--	--
No.15	175	73	65	68	119	--	--
No.16	183	65	74	68	124	--	--
No.17	178	--	--	76	135	--	--
No.18	184	--	--	76	139	--	--
No.19	175	57	68	60	105	--	--
MEAN	**174.7**	**68.3**	**67.5**	**68.8**	**120**	**--**	**--**

*V = Verbal
*N = Non-verbal
*P = Performance
*F = Full Scale
-- = Score not available

The Instruments

Published Instruments.

The following measures of intellectual level and general achievement were taken by the school. The measures served primarily as criteria for the selection of subjects for the study.

1. Wechler Intelligence Scale for Children - Revised (WISC-R) for MMD group -- Full scale IQ scores on the WISC-R administered by the School Board were used as one of the subject selection criteria.

The WISC-R was published in 1974. It provides Deviation IQs for the Verbal, Performance, and Full Scale (M=100, SD=15) and standard scores for the 12 subtests (M=10, SD=3). The average standard errors of measurement (SEm) in IQ points are 3.19 for the Full Scale, 3.60 for the Verbal Scale, and 4.66 for the Performance Scale. Although Wechsler objected to the use of mental ages in the calculation of IQs, the WISC-R manual includes a table of test-age equivalents for the scaled scores: these are essentially mental-age scores (Sattler, 1988).

The internal consistency reliability of the Verbal, Performance, and Full Scales are excellent (average of .94, .90 and .96 respectively). Subtest reliabilities range from .70 to .86. The WISC-R has acceptable criterion validity, median correlations with measures of achievement and school grades range from the upper .30s to the low .80s. The WISC-R has acceptable concurrent validity. Correlations with other Wechsler scales and with the Standford-Binet: Fourth Edition are in the .70s to .80s. The WISC-R factor structure found in a variety of ethnic groups and exceptional populations generally is similar to that found in the standardization sample.

2. Canadian Cognitive Abilities Test (CCAT) -- CCAT verbal and non-verbal scores for the AI group administered by school were used to verify whether the subjects met the selection criteria as having an average intelligence.

CCAT was developed by the Toronto Board of Education. It provides

three sub-scores on intelligence -- verbal intelligence, quantitative intelligence and non-verbal intelligence. The verbal battery consists of four subtests: vocabulary, sentence completion, verbal classification, and verbal analogies. The quantitative battery consists of three subtests: quantitative relations, number series, and equation building. The non-verbal battery consists of three subtests: figure classification, figure analogies, and figure synthesis. The CCAT was administered to the subjects in this study by the school when they were in Grade 3. Means of verbal IQ, quantitative IQ, and non-verbal IQ obtained from the Grade 3 students in the Edmonton Public School population are 108.1, 104.0 and 104.1 with standard deviations of 14.5, 15.3, and 15.9 respectively.

The reliability coefficients of the CCAT were computed by the Kuder-Richardson Formula #20 for each subscale. The KR #20 reliability estimates was .948 for the verbal battery, .889 for the quantitative battery, and .922 for the non-verbal battery. The validity of the CCAT was calculated by correlating the CCAT with the tests of educational achievement given at the same time as part of the common standardization testing. In grade 3, the Canadian Tests of Basic Skills (CTBS) was given as the achievement test. The composite correlation between standard age scores on the CCAT and the grade-equivalent scores on the Canadian Tests of Basic Skills was .85 for the verbal battery, .72 for the quantitative battery, and .63 for the non-verbal battery.

3. The Canadian Tests of Basic Skills (CTBS) -- CTBS consists of three different but hierarchically ordered levels of test batteries. These are the primary battery, the multi-level battery and the high school battery. Each battery of tests has a number of levels which correspond to school grades, and is available in two forms. The primary battery consists of levels 5 to 14 which correspond to grades from kindergarten through 8. This battery was administered by the School Board to Al subjects in this study.

Among the specific purposes which the CTBS was designed to serve are the determination of the level of each student in order to adapt materials and instructional procedures more precisely to individual needs and abilities and for

the diagnosis of strengths and weaknesses in a student's educational development. The test can also be used for the diagnosis of strengths and weaknesses in group performance which have implications for change in curriculum or instructional procedures or emphasis.

The CTBS was standardized jointly with the CCAT in the Fall of 1980 in Canada. The sample of 3200 students per grade was drawn from Canadian schools in which English was the major language of instruction. It was claimed by the test makers that the large national sample chosen was representative of all the Canadian provinces and different school sizes.

According to the authors of the tests, internal consistency reliability coefficients for the five main area scores range from .87 to .96. These five main areas are: vocabulary, reading, language skills, writing and mathematics. Composite reliability for all grades is .97 to .98 (King et al., 1980).

Investigator-designed information form and instruments.

1. Subject Background Information Form -- This is a form designed to collect background information on subjects (see Appendix A). The information was used to ascertain if the subjects met the selection criteria. The form was completed by the investigator based on information collected from the teachers and the records in school.

2. Instrument No. 1: Teacher Questionnaire on Memory Strategy (see Appendix B) -- The purpose of this Instrument was to obtain information on the subjects' initial state of memory strategies, attributions about success and failure, and learning behaviors as perceived and predicted by their teachers under different conditions and occasions. The Questionnaire included a section on the administration procedures, the types of strategies the study was concerned with and examples of these strategies. The questionnaire was given to the teachers in September and was returned in December of the same year. Classroom teachers, based on their observations, prediction and experience with the subjects, completed the Instrument. They were requested not to test

the subjects with the tasks as the tasks were identical with those in Instrument No. 2.

3. Instrument No. 2: Subject Self-Report on Memory Strategy (see Appendix C) -- The purpose of this Instrument was to obtain information on the subjects' initial state of memory strategies, attributions about success and failure, and learning behaviors as they perceived them. The subjects were required to describe their memory strategies to the investigator prior to task performance. The instrument included three sections: a) administration procedures and instructions, b) twelve memory tasks for the subjects which were identical to those in Instrument No. 1, and c) questions on attributions and learning behaviors which were identical to those in Instrument No. 1.

This instrument was administered to the subjects by the investigator. The subjects in each group were individually trained in the think-aloud procedure (see Appendix E). They were then interviewed by the investigator and presented with the twelve tasks in the Instrument. They were not required to remember the information or to perform the tasks but requested to describe as many strategies as possible if they were to perform the tasks. After they had completed the twelve tasks, questions on attributions and learning behaviors were asked. Their answers were tape-recorded for later analysis.

4. Instrument No. 3: Investigator Assessment of Memory Strategies (see Appendix D) -- The purpose of this Instrument was to obtain information on the subjects' initial state of memory strategies by administering assessment tasks. The instrument includes details of administration procedures and the twelve memory tasks. During the assessment sessions, the twelve tasks were administered to each individual subject by the investigator. The subjects were required to think-aloud their strategies while performing and after performing the memory tasks. The subjects' answers were tape-recorded for later protocol analysis.

All three instruments included tasks to remember a list of colours, names, non-meaningful numbers, items to be categorized, main points read or

heard from factual or descriptive stories, verbal or written instructions. A summary of the nature of the memory tasks is in Table 3.

Scoring and Analysis

Scoring.

A rating sheet for Instruments No. 1, 2, and 3 was devised to record the presence and incidence of memory strategies of the subjects (see Appendix G). Scoring criteria which list behaviourial observations for the memory strategies were drawn up prior to the Pilot Study. Sample responses were added to the scoring criteria after collecting data for the main study. The scoring criteria and sample responses were used by both the investigator and the rater for scoring purposes. The scoring criteria and sample responses can be found in Appendix F.

Grouping of data.

In order to answer the research questions, collected data were analyzed and categorized into the following groups:

1. The initial state of memory strategies -- Data collected from Instruments No. 1, 2, and 3 yield information on the subjects' initial state of memory strategies and the types of strategies.

2. Attributions and learning behaviors -- Data collected from Instruments No. 1 and No. 2 give general information on the teachers' perceptions and the subjects' perceptions of learning behaviors and attributional beliefs about success and failure.

3. Reliability and feasibility of the assessment approach -- Data collected from instruments No. 2 and No. 3 were analyzed by the investigator and another rater who was a PH.D. student in Educational Psychology. Interrater reliability was calculated to estimate the usability and accuracy of scoring the instruments. The method of calculating the agreement is described in the data analysis section. A comparison was then made between data obtained from Instrument No. 1, 2 and 3 to yield information on the difference between teachers' predictions, subjects' report on memory strategies prior to

task performance, and the subjects' reports of strategy use as indicated in investigator's assessment results. This comparison of data also provides a global picture of the subjects' initial state of memory strategies, attributions and learning behaviors.

4. Comparison between the MMD and the AI groups -- The two groups were compared in terms of their initial state of memory strategies, attributions and learning behaviors.

Data analysis.

The tape-recorded verbal responses of the subjects were transcribed word by word into a written account. To determine the reliability of the scoring procedure, an independent scorer with no information about skill levels of the subjects was asked to score the verbal responses. The investigator and the rater first met to discuss the scoring criteria (see Appendix F). According to the scoring criteria, one point is given to responses reflecting the presence of a memory or regulatory strategy. The investigator and the rater then individually reviewed the transcriptions of the subjects' verbal responses to Instruments No. 2 and 3. The purpose of rater review was to ensure the consistency of rater judgements. During the reviews, a scanning procedure was used to determine the nature of the content of the answers and a careful analysis of presenting strategies was used to verify the nature and extent of strategies. The final review verified the nature and extent of strategies identified.

As this study focused on the practical significance, clinical significance and educational implications, rather than statistical significance of the results, data collected were analyzed qualitatively. Descriptive statistics such as means and percentages were used. To assess reliability of the results, interrater reliability was sought by using the point by point method suggested by Tawney and Gast (1984, p.139). The records of the two observers were examined. When there was agreement that a memory strategy was noted, one count was given. The sum of these counts, divided by the total of agreements plus

disagreements multiplied by 100 yielded a percent of agreement measure:

$$\frac{\text{Agreement}}{\text{Agreement + Disagreement}} \times 100 = \text{Percent of Agreement}$$

one that increases confidence that the observers record and identify the same strategy. It is noted that this estimate does not account for one part of the data set -- agreement that a behavior did not occur. However, as it is difficult to measure which strategy should occur but did not occur, the point by point method seems to be more appropriate for this study.

The point by point method was also used to calculate the agreement of results among the three instruments, and the agreement of scoring correct responses during the assessment sessions.

TABLE 3

Nature of the Memory Tasks

	Nature of Tasks		Items in Instrument #1	#2	#3
	List				
1.	To recall a list of colours		1	1	1
2.	To recall a list of names		2	2	2
3.	To recall non-meaningful numbers		7	7	6
4.	To recall numbers which have to be grouped		8	8	9
5.	To recall items which can be categorized	(a)	9	9	4
		(b)	10	10	5
	Information				
6.	To recall main points in a factual story read		5	5	10
7.	To recall main points in a descriptive story read		6	6	7
8.	To recall main points in a factual story heard		3	3	3
9.	To recall main points in a descriptive story heard		4	4	12
	Procedure and Instruction				
10.	To recall verbal instructions		11	11	8
11.	To recall procedures to complete a task read from a book		12	12	11

CHAPTER IV
RESULTS

Introduction

The results of the present study are presented in four sections. The first section summarizes the teachers' perceptions and observations of the subjects' entry-level memory strategies and learning behaviors. The second section documents the results obtained from the subjects' self-reports of memory strategies and learning behaviors. The third section deals with the investigator's assessment results on the memory strategies the subjects reported using. The fourth section integrates the results of the teachers' perceptions and observations, the subjects' self-reports, and the investigator's assessment.

The Results of the Teachers' Perceptions and Observations

The subjects' teachers were requested to complete Instrument No. 1: Teacher Questionnaire on Memory Strategies (Appendix B). This questionnaire was to be completed based upon the teachers' predictions, previous knowledge of the subjects, and observations of the subjects in various learning situations for two months. The teachers were asked not to test the subjects on the memory tasks found in the teachers' questionnaire because the tasks were identical to those in Instrument No. 2: Subject Self-Report on Memory Strategies, which was to be administered by the investigator. The subjects came from four different homerooms, thereby allowing four teachers, two from each group, to complete the questionnaire. Summaries of the results from Instrument No. 1 are presented in Tables 4, 5 and 6. The results from Instrument No. 1 have been divided into two topic headings: a) memory strategies, and b) attributions and learning behaviors.

Memory Strategies

Methods of assessment.

The questionnaire asked teachers how they assessed the subjects' memory strategies. One teacher of the AI group reported the use of tests and written assignments, as well as observation during classes and other situations. The other three teachers, one from AI group and two from MMD group, observed the subjects' memory performance in classes and on other occasions.

Awareness and use of memory strategies.

Table 4 summarizes the percentage and frequency of the subjects' memory strategies as perceived and predicted by their teachers. Results of Instrument No. 1 completed by the two classroom teachers of the Average Intelligence group (AI) indicated that all ten AI subjects were predicted to be aware of, or likely to use memory strategies. The total frequency of memory strategies reported by the AI teachers for the twelve tasks found in Instrument No. 1 was 127 with a mean frequency of 12.7. The teachers predicted that two subjects (subjects no. 2 and 3) in this group would use more than one strategy for a task, whereas the other eight subjects would use only one strategy for each memory task.

The two teachers of the Mildly Mentally Disabled group (MMD) predicted that all nine subjects in this group would be aware of, or would use, memory strategies. The total frequency of memory strategies the MMD subjects would likely use for the twelve tasks was 110 with a mean frequency of 12.2. The teachers predicted that one subject (subject No. 19) in this group would use more than one memory strategy for a task, whereas the other eight subjects would use only one strategy to memorize each task.

Strategies used more often.

The teachers recognized that some strategies would be used more frequently than others (see Table 4). The teachers predicted that the AI group would use visual imagery 44% of the time (f=56), maintenance rehearsal 28% of

the time (f=35), first-letter mnemonics 17% of the time (f=22) and elaborative rehearsal 11% of the time (f=14).

The teachers predicted that the MMD group would use mainly maintenance rehearsal (f=108). It was predicted that only one subject (subject No. 19) would use elaborative rehearsal (f=2).

Types of strategies.

According to the perceptions and predictions of the teachers, all the AI subjects, except two, would be aware of, or would use the four types of strategies: maintenance rehearsal, elaborative rehearsal, visual imagery, and mnemonics. It was predicted that one subject (subject No. 1) would not demonstrate usage of elaborative rehearsal, while another subject (subject No. 4) would not demonstrate usage of mnemonics. The teachers did not describe which elaborative rehearsal strategy or mnemonic the eight subjects would utilize. Although the teachers were requested to specify other strategies observed, they failed to indicate in the questionnaires whether the subjects were knowledgeable in other types of memory strategies or regulatory strategies.

Based on the predictions of the teachers, the MMD group would use maintenance rehearsal and elaborative rehearsal strategies. The teachers expected that eight out of the nine subjects would use only maintenance rehearsal to remember the tasks. The teachers predicted that only one subject (subject No. 19) in the MMD group would use both maintenance rehearsal and elaborative rehearsal. The teachers did not provide further information on which type of elaborative rehearsal this subject was likely to use. The teachers did not report any subjects' awareness or use of visual imagery, mnemonics, regulatory strategies or other types of memory strategies.

TABLE 4

Teacher Observations and Prediction: Percentage and Frequency of Memory Strategies
(N: AI = 10, MMD = 9)

Subject	Strategy: Percentage (Frequency) MR	ER	VI	MS
Average Intelligence Group (AI)				
No. 1	17%(2)	0%(0)	75%(9)	8%(1)
No. 2*	29%(5)	12%(2)	35%(6)	24%(4)
No. 3*	31%(5)	13%(2)	50%(8)	6%(1)
No. 4	46%(5)	18%(2)	36%(4)	0%(0)
No. 5	8%(1)	8%(1)	50%(6)	34%(4)
No. 6	46%(5)	18%(2)	18%(2)	18%(2)
No. 7	17%(2)	9%(1)	58%(7)	16%(2)
No. 8	25%(3)	9%(1)	50%(6)	16%(2)
No. 9	33%(4)	9%(1)	33%(4)	25%(3)
No.10	25%(3)	17%(2)	33%(4)	25%(3)
Mean % :	**28%**	**11%**	**44%**	**17%**
Frequency:	**35**	**14**	**56**	**22**
Total frequency of strategies:		**127**		
Mean frequency of strategies for the 12 tasks :			**12.7**	
Mean type of strategies each subject would use:			**3.8**	
Mildly Mentally Disabled Group (MMD)				
No.11	100%(12)	0%(0)	0%(0)	0%(0)
No.12	100%(12)	0%(0)	0%(0)	0%(0)
No.13	100%(12)	0%(0)	0%(0)	0%(0)
No.14	100%(12)	0%(0)	0%(0)	0%(0)
No.15	100%(12)	0%(0)	0%(0)	0%(0)
No.16	100%(12)	0%(0)	0%(0)	0%(0)
No.17	100%(12)	0%(0)	0%(0)	0%(0)
No.18	100%(12)	0%(0)	0%(0)	0%(0)
No.19*	86%(12)	14%(2)	0%(0)	0%(0)
Mean %:	**98%**	**2%**	**0%**	**0%**
Frequency:	**108**	**2**	**0**	**0**
Total frequency of strategies:		**110**		
Mean frequency of strategies for the 12 tasks:			**12.2**	
Mean type of strategies each subject would use:			**1.1**	

MR = Maintenance Rehearsal Strategy
ER = Elaborative Rehearsal Strategy
VI = Visual Imagery
MS = Mnemonics
* = Subject who would use more than one memory strategy for a task

Types of memory strategies and nature of tasks.

According to the teachers' reports, the type of memory strategies the subjects adopted would depend on the nature of the tasks or the type of information the subjects had to remember. Table 5 summarizes the predictions of the teachers in regards to the types and percentage of memory strategies the subjects would most likely use when presented with different forms of information to remember.

The teachers expected the subjects in the AI group to use different strategies when provided with different information to remember. The teachers suggested that the AI group would use visual imagery 55% of the time to remember a list of colours and maintenance rehearsal 70% of the time to memorize non-meaningful numbers or numbers to be grouped. The teachers also predicted that the AI group would apply all four types of strategies to remember lists of names and items which can be categorized. When given main points from descriptive stories they had read or heard, the subjects in the AI group would use visual imagery (80% to 100%) more often to recall the information. If the main points to be memorized were from factual stories, the teachers indicated that the AI group would use visual imagery (33% to 40%) or maintenance rehearsal (30% to 34%). When the subjects were required to remember verbal instructions, they would likely apply visual imagery (55%) or mnemonics (36%) more often than other strategies. When the subjects were asked to memorize instructions or procedures read from a book, the teachers suggested that the subjects would use elaborative rehearsal (33%) or mnemonics (33%) more frequently than other strategies. The teachers did not describe which elaborative rehearsal or mnemonic strategies the subjects would apply.

TABLE 5

Teacher Observations and Prediction: Types of Memory Strategies
(N: AI = 10, MMD = 9)

Nature of Memory Task		Memory Strategy MR	ER	VI	MS
Average Intelligence Group (AI)					
List of colours in correct serial order		18%	18%	55%	9%
List of names		20%	30%	30%	20%
Series of non-meaningful numbers		70%	0%	30%	0%
Numbers to be grouped		70%	0%	20%	10%
Items to be categorized	(a)	27%	9%	37%	27%
	(b)	21%	29%	29%	21%
Main points read from factual story		34%	11%	33%	22%
Main points read from descriptive story		0%	0%	100%	0%
Main points heard from factual story		30%	10%	40%	20%
Main points heard from descriptive story		20%	0%	80%	0%
Verbal instructions		9%	0%	55%	36%
Procedure read from a book		17%	33%	17%	33%
Mildly Mentally Disabled Group (MMD)					
List of colours in correct serial order		100%	0%	0%	0%
List of names		100%	0%	0%	0%
Series of non-meaningful numbers		100%	0%	0%	0%
Numbers to be grouped		100%	0%	0%	0%
Items to be categorized	(a)	90%	10%	0%	0%
	(b)	100%	0%	0%	0%
Main points read from factual story		90%	10%	0%	0%
Main points read from descriptive story		100%	0%	0%	0%
Main points heard from factual story		100%	0%	0%	0%
Main points heard from descriptive story		100%	0%	0%	0%
Verbal instructions		100%	0%	0%	0%
Procedure read from a book		100%	0%	0%	0%

MR = Maintenance Rehearsal Strategy
ER = Elaborative Rehearsal Strategy
VI = Visual Imagery
MS = Mnemonics

The teachers predicted that the MMD subjects would use maintenance rehearsal strategies 90% to 100% of the time when they were asked to memorize different lists, main points they had heard or read from factual or descriptive stories, procedures they had read and verbal instructions they had heard. It was predicted that one MMD subject (subject No. 19) would likely use elaborative rehearsal when asked to memorize categorizable items or main points to be read from factual stories. The teachers did not elaborate on how the subject would engage in elaborative rehearsal.

Attributions and Learning Behaviors

Attributions of success and failure.

As previously mentioned, this study adopted a restricted use of attribution and focused on attributions of success and failure. Table 6 summarizes the teachers' perceptions and observations of the subjects' attributions and learning behaviors. As predicted by the teachers, all the AI subjects (n=10) would attribute their success to effort, ability and skill. In contrast, a majority of the MMD subjects (n=8) would attribute their success to chance and luck. Only one MMD subject (subject No.13) would attribute his/her success to effort, ability and skill.

The teachers predicted that all AI and MMD subjects (n=19) would attribute the reason for their failure to their lack of ability, skill or effort, rather than luck.

Learning behaviors.

Generally, the AI subjects were considered by the teachers to be active learners. The teachers predicted that when the AI subjects were required to problem-solve, all ten of them would look for alternative methods. The teachers reported that a majority (n=8) would be motivated to learn new information that would be of interest to them. Six of them would spend time learning materials which they knew would not be asked on the examinations. The teachers also suggested that when the AI subjects were given assignments to do, all of them would tackle the tasks as soon as assigned. The majority (n=9) would spend

adequate time doing the assignments. Eight of the AI subjects were reported as individuals who would proof-read their work without being requested to do so. In the affective area, all ten AI subjects were described by the teachers as "persons with confidence". The teachers also indicated that the majority of AI subjects (n=7) would not be put off by poor marks in an examination, nor would they be inclined to give up. The teachers predicted that nine of the AI participants would likely worry about their examination results even when they had studied adequately.

The teachers reported that when the MMD subjects were required to solve problems, some (n=5) would look for alternate ways of problem solving, while some (n=4) would consistently use only one method of problem solving. In learning situations, teachers suggested that most of the MMD subjects (n=8) were motivated to learn information they found interesting. However, they (n=8) would not spend time on learning information which would not be tested in examination situations. If given assignments to do, the teachers predicted that some of the MMD subjects (n=5) would do the assignments as soon as possible, whereas some (n=4) would not. The teachers predicted that some of the MMD subjects (n=4) would spend adequate time on doing assignments, whereas some (n=5) would not. It was suggested that most of them (n=7) would not proof-read the assignments if they were not requested to do so. In the affective area, all the MMD subjects (n=9) were described by the teachers as "persons with confidence". The teachers also believed that most MMD subjects (n=7) would worry about examination results, even when they adequately prepared. In contrast to their AI counterparts, seven MMD subjects were predicted to be put off by poor marks, and would likely give up easily.

TABLE 6

Teacher Observations and Prediction: Attributions and Learning Behaviors
(N: AI=10, MMD=9)

Behavior		Perceptions % (No. of Subjects) AI	MMD
Attributions			
1. Reason for success:			
	Effort/skill/ability	100%(10)	11%(1)
	Chance/luck	0%(0)	89%(8)
	Both	0%(0)	0%(0)
2. Reason for failure:			
	Lack ability/skill/effort	100%(10)	100%(9)
	Lack luck	0%(0)	0%(0)
	Lack both	0%(0)	0%(0)
Learning Behaviors			
3. Look for alternate ways to solve problems:			
	Yes/ Sometimes	100%(10)	56%(5)
	No	0%(0)	44%(4)
4. Motivated to learn interesting new information:			
	Yes/ Sometimes	80%(8)	89%(8)
	No	20%(2)	11%(1)
5. Spend time to learn things which will not be asked:			
	Yes/ Sometimes	60%(6)	11%(1)
	No	40%(4)	89%(8)
6. Put off by poor mark and give up easily:			
	Yes/ Sometimes	30%(3)	78%(7)
	No	70%(7)	22%(2)
7. Worry about results even when s/he studies hard:			
	Yes/ Sometimes	90%(9)	78%(7)
	No	10%(1)	22%(2)
8. Described as a person with confidence:			
	Yes/ Sometimes	100%(10)	100%(9)
	No	0%(0)	0%(0)
9. Proof read work without a request to do so:			
	Yes/ Sometimes	80%(8)	22%(2)
	No	20%(2)	78%(7)
10. Do assignments as soon as they are given:			
	Yes/ Sometimes	100%(10)	56%(5)
	No	0%(0)	44%(4)
11. Spend adequate time on doing assignments:			
	Yes/ Sometimes	90%(9)	44%(4)
	No	10%(1)	56%(5)

AI = Average Intelligence Group
MMD = Mildly Mentally Disabled Group

The Results of the Subjects' Self-Reports

After the AI and MMD subjects were individually trained in the think-aloud procedure (Appendix E), they were interviewed by the investigator. During the interviews, the twelve tasks in Instrument No. 2: Subject Self-Report on Memory Strategies (Appendix C) were administered. During the interviews, the subjects were not required to perform the twelve tasks or to remember the information. The subjects were simply requested to think-aloud and describe as many strategies as possible if they were to remember the information. Questions on attributions and learning behaviors which were similar to those in Instrument No. 1 were asked of the subjects. A summary of the subjects' reports is presented in Tables 7 to 11 and discussed below under the topics: a) memory strategies and b) attributions and learning behaviors. Another person independently rated the subjects' verbal reports. The interrater reliability is presented in Table 7. The reliability was high with a finding of 95.6% reliability for the AI group and 94.4% for the MMD group. The method of calculating agreement was discussed in Chapter 3.

Memory Strategy

Awareness and use of memory strategies.

Based on the self-reports of the subjects summarized in Table 8, all the AI subjects were aware of, or used, memory strategies. The total frequency of memory strategies reported by the AI group for the twelve tasks was 153 with a mean frequency of 15.3. Nine subjects in the AI group described the use of more than one strategy for each task. One subject (subject No.6) reported the use of only one strategy for each task. This subject reported using maintenance rehearsal, elaborative rehearsal and visual imagery in isolated circumstances.

TABLE 7

Subject Self-Report: Interrater Reliability
(N: AI = 10, MMD =9)

Strategy	Frequency Agreement AI	Frequency Agreement MMD	Frequency Disagreement AI	Frequency Disagreement MMD	Interrater Reliability AI	Interrater Reliability MMD
Memory Strategies						
MR	43	68	3	6		
ER	57	20	1	2		
VI	41	44	0	0		
MS	11	1	0	0		
Other Strategies						
Atten.	21	13	2	2		
Assist.	66	53	5	3		
Immed.	3	8	1	0		
Check	20	12	0	0		
					95.6%	94.4%
TOTAL:	**262**	**219**	**12**	**13**	**95%**	

AI = Average Intelligence Group
MMD= Mildly Mentally Disabled Group
MR = Maintenance Rehearsal Strategy
ER = Elaborative Rehearsal Strategy
VI = Visual Imagery
MS = Mnemonics
Atten. = Attentional factors
Assist. = Obtain assistance
Immed. = Perform the tasks immediately
Check = Check results

TABLE 8

Subject Self-Report: Percentage and Frequency of Memory Strategies
(N: AI =10, MMD =9)

Subject	Strategy: Percentage (Frequency) MR	ER	VI	MS
Average Intelligence Group (AI)				
No. 1*	35%(6)	24%(4)	41%(7)	0%(0)
No. 2*	14%(2)	72%(10)	7%(1)	7%(1)
No. 3*	0%(0)	31%(6)	53%(10)	16%(3)
No. 4*	57%(8)	7%(1)	22%(3)	14%(2)
No. 5*	18%(3)	18%(3)	47%(8)	17%(3)
No. 6	58%(7)	33%(4)	9%(1)	0%(0)
No. 7*	53%(8)	20%(3)	20%(3)	7%(1)
No. 8*	33%(5)	40%(6)	27%(4)	0%(0)
No. 9*	27%(4)	60%(9)	13%(2)	0%(0)
No.10*	7%(1)	73%(11)	13%(2)	7%(1)
Mean:	**29%**	**37%**	**27%**	**7%**
Frequency:	**44**	**57**	**41**	**11**
Total frequency of strategies:	**153**			
Mean frequency of strategies for the 12 tasks:	**15.3**			
Mean type of strategies each subject used:	**3.6**			
Mentally Disabled Group (MMD)				
No.11	75%(9)	25%(3)	0%(0)	0%(0)
No.12	92%(11)	8%(1)	0%(0)	0%(0)
No.13*	62%(8)	15%(2)	23%(3)	0%(0)
No.14*	73%(11)	7%(1)	20%(3)	0%(0)
No.15*	38%(6)	6%(1)	56%(9)	0%(0)
No.16*	26%(5)	26%(5)	42%(8)	6%(1)
No.17*	57%(8)	29%(4)	14%(2)	0%(0)
No.18*	32%(6)	10%(2)	58%(11)	0%(0)
No.19*	47%(8)	6%(1)	47%(8)	0%(O)
Mean %:	**53%**	**14%**	**32%**	**1%**
Frequency:	**72**	**20**	**44**	**1**
Total frequency of strategies:	**137**			
Mean frequency of strategies for the 12 tasks:	**15.2**			
Mean type of strategies each subject used:	**2.9**			

MR = Maintenance Rehearsal Strategy
ER = Elaborative Rehearsal Strategy
VI = Visual Imagery
MS = Mnemonics
* = Subject who would use more than one memory strategy for a task

During the interviews, the subjects in the MMD group also described their awareness or use of memory strategies. The total frequency of memory strategies reported by the MMD group for the twelve tasks was 137 with a mean frequency of 15.2. Mean frequencies in both the AI and MMD groups were similar. Two MMD subjects (subjects No. 11 and 12) described the use of one strategy for each memory task. Seven MMD subjects described the use of more than one strategy for each memory task.

Memory strategies used more often.

Examples of strategies the subjects described can be found in Appendix G. The strategies the AI subjects described in the think-aloud procedure were mostly elaborative rehearsal (f=57). The AI subjects indicated they would also use maintenance rehearsal (f=44) and visual imagery (f=41). Mnemonics (f=11) were discussed less frequently by the AI subjects (see Table 8).

The subjects in the MMD group described maintenance rehearsal as the strategy they were most likely to utilize (f=72). Other memory strategies the MMD group described included visual imagery (f=44), elaborative rehearsal (f=20) and mnemonics (f=1). The MMD subject who mentioned mnemonics was able only to use the first-letter mnemonics.

Other strategies or regulatory behaviors that the AI group reported to use more frequently (see Table 9) included obtaining assistance from others (f=70), checking the results of memorizing (f=20), paying attention and concentrating (f=23), and performing the tasks immediately to avoid memory failure (f=4).

Other regulatory strategies that the MMD subjects reported that they would use more frequently were similar to those of the AI group (see Table 9). The most preferred strategy was to obtain assistance from others (f=55). The MMD subjects also indicated the importance of paying attention (f=15), checking the results of memorization (f=12) and performing the tasks as soon as possible so that they would not forget the tasks (f=8).

TABLE 9

Subject Self-Report: Other Strategies
(N: AI = 10, MMD = 9)

Subject	Other Strategies: Percentage (Frequency) A	OA	DA	CR	Total f
Average Intelligence Group (AI)					
No.1	50%(7)	36%(5)	7%(1)	7%(1)	14
No.2	0%(0)	69%(9)	8%(1)	23%(3)	13
No.3	0%(0)	71%(5)	0%(0)	29%(2)	7
No.4	35%(6)	53%(9)	6%(1)	6%(1)	17
No.5	8%(1)	61%(8)	0%(0)	31%(4)	13
No.6	29%(5)	65%(11)	0%(0)	6%(1)	17
No.7	22%(2)	67%(6)	0%(0)	11%(1)	9
No.8	0%(0)	70%(7)	0%(0)	30%(3)	10
No.9	15%(2)	70%(9)	0%(0)	15%(2)	13
No.10	0%(0)	25%(1)	25%(1)	50%(2)	4
Mean %	**15.9%**	**58.7%**	**4.6%**	**20.8%**	
Total f	**23**	**70**	**4**	**20**	**117**
Mean f	**2.3**	**7.0**	**0.4**	**2**	**11.7**
Mildly Mentally Disabled Group (MMD)					
No.11	0%(0)	64%(7)	0%(0)	36%(4)	11
No.12	50%(3)	50%(3)	0%(0)	0%(0)	6
No.13	23%(4)	47%(8)	18%(3)	12%(2)	17
No.14	13%(2)	47%(7)	20%(3)	20%(3)	15
No.15	0%(0)	86%(6)	14%(1)	0%(0)	7
No.16	33%(2)	50%(3)	17%(1)	0%(0)	6
No.17	40%(2)	60%(3)	0%(0)	0%(0)	5
No.18	0%(0)	79%(11)	0%(0)	21%(3)	14
No.19	22%(2)	78%(7)	0%(0)	0%(0)	9
Mean %	**20%**	**62%**	**8%**	**10%**	
Total f	**15**	**55**	**8**	**12**	**90**
Mean f	**1.7**	**6.1**	**0.9**	**1.3**	**10**

A = Attention, concentration and understanding
OA = Obtain assistance from others or use cues
DI = Do the task immediately
CR = Check results of memorizing

Types of strategies.

The types of strategies reported by the AI subjects included maintenance rehearsal, elaborative rehearsal, visual imagery, mnemonics and other regulatory strategies. The mnemonic strategy was limited to first-letter mnemonics. Five subjects in the AI group (subjects No. 2, 4, 5, 7, and 10) described the use of all four types of strategies previously mentioned. One of the subjects (subject No. 3) did not describe the use of maintenance rehearsal, while four subjects (subjects No. 1, 6, 8, and 9) did not mention mnemonics. All AI ten subjects indicated that they would adopt other regulatory strategies to help them recall. Examples of such strategies were paying attention, obtaining assistance from others, doing the task immediately, and checking the results of memorizing. Table 9 summarizes the frequency of other regulatory strategies mentioned by the subjects.

The types of strategies the MMD subjects reported to use, included all four strategies previously discussed, as well as regulatory strategies described in Table 9. All nine MMD subjects reported that they would use maintenance rehearsal and elaborative rehearsal strategies. Seven subjects reported they would use visual imagery, and only one subject (subject No. 16) indicated he/she would use first-letter mnemonics.

Types of memory strategies and the nature of the tasks.

According to the self-reports of the subjects, their application of the type of memory strategies would be in relation to the nature of the tasks. Table 10 summarizes the type and percentage of memory strategies the subjects reported to use when given different information to remember.

AI subjects indicated they would apply different memory strategies when remembering different types of lists. When the AI subjects had to remember a list of colours or numbers, they reported that they would use maintenance rehearsal 43% to 55% of the time. If the lists were names or items which could be categorized, they indicated they would use elaborative rehearsal more often (43% to 70%). When asked to remember information read from a factual story,

they reported the use of elaborative rehearsal 50% of the time. When asked to recall information read from a descriptive story, they indicated using visual imagery 42% of the time. Subjects from the AI group reported applying maintenance rehearsal, elaborative rehearsal, as well as visual strategies to remember main points heard from factual or descriptive stories, verbal instructions or procedures read from a book. First-letter mnemonics was the strategy not often mentioned, except in memorizing categorizable items (such as daily objects, food) and following written procedures.

When the MMD subjects had to remember lists of colours and numbers, they indicated they would use maintenance rehearsal 58% to 82% of the time. When memorizing lists of names or items which could be categorized, the MMD subjects reported using maintenance rehearsal, elaborative rehearsal and visual imagery. When memorizing main points heard or read from factual stories, they indicated the preference for maintenance rehearsal (64% to 73%). When they had to remember main points heard or read from descriptive stories, they reported applying visual imagery slightly more often (42% to 46%). When asked to follow verbal instructions, the MMD subjects indicated a tendency to use maintenance rehearsal (42%) and visual imagery (50%). When following a procedure read from a book, they indicated a preference for maintenance rehearsal (64%). They did not report the use of elaborative rehearsal in memorizing a list of colours, main points read from factual stories or procedures read from a book. Eight of the nine MMD subjects did not mention using mnemonics in any of the tasks. The only MMD subject (subject No. 16) who mentioned the first-letter mnemonics indicated that he/she would apply the strategy to remember a list of colours.

TABLE 10

Subject Self-Reports: Types of Memory Strategies
(N: AI = 10, MMD = 9)

Nature of Memory Task		Memory Strategy MR	ER	VI	MS
Average Intelligence Group (AI)					
List of colours in correct serial order		43%	21%	7%	29%
List of names		10%	70%	20%	0%
Series of non-meaningful numbers		55%	27%	18%	0%
Numbers to be grouped		50%	30%	20%	0%
Items to be categorized	(a)	8%	46%	38%	8%
	(b)	15%	43%	21%	21%
Main points read from factual story		21%	50%	29%	0%
Main points read from descriptive story		29%	29%	42%	0%
Main points heard from factual story		23%	31%	38%	8%
Main points heard from descriptive story		28%	36%	36%	0%
Verbal instructions		38%	38%	24%	0%
Procedure read from a book		31%	31%	23%	15%
Mildly Mentally Disabled Group (MMD)					
List of colours in correct serial order		58%	0%	33%	9%
List of names		40%	30%	30%	0%
Series of non-meaningful numbers		82%	9%	9%	0%
Numbers to be grouped		67%	8%	25%	0%
Items to be categorized	(a)	58%	17%	25%	0%
	(b)	16%	42%	42%	0%
Main points read from factual story		73%	0%	27%	0%
Main points read from descriptive story		33%	25%	42%	0%
Main points heard from factual story		64%	18%	18%	0%
Main points heard from descriptive story		36%	18%	46%	0%
Verbal instructions		42%	8%	50%	0%
Procedure read from a book		64%	0%	36%	0%

MR = Maintenance Rehearsal Strategy
ER = Elaborative Rehearsal Strategy
VI = Visual Imagery
MS = Mnemonics

TABLE 11

Subject Self-Report: Attributions and Learning Behaviors
(N: AI=10, MMD=9)

Behavior	Perceptions % (No. of Subjects) AI	MMD
Attributions		
1. Reason for success:		
Effort/skill/ability	90%(9)	78%(7)
Chance/luck	0%(0)	0%(0)
Both	10%(1)	22%(2)
2. Reason for failure:		
Lack ability/skill/effort	100%(10)	44%(4)
Lack luck	0%(0)	44%(4)
Lack both	0%(0)	12%(1)
Learning Behaviors		
3. Look for alternate way to solve problems:		
Yes/ Sometimes	90%(9)	22%(2)
No	10%(1)	78%(7)
4. Motivated to learn interesting new information:		
Yes/ Sometimes	100%(10)	100%(9)
No	0%(0)	0%(0)
5. Spend time to learn things which will not be asked:		
Yes/ Sometimes	90%(9)	44%(4)
No	10%(1)	56%(5)
6. Put off by poor mark and give up easily:		
Yes/ Sometimes	40%(4)	78%(7)
No	60%(6)	22%(2)
7. Worry about results even when s/he studies hard:		
Yes/ Sometimes	90%(9)	100%(9)
No	10%(1)	0%(0)
8. Described as a person with confidence:		
Yes/ Sometimes	100%(10)	89%(8)
No	0%(0)	11%(1)
9. Proof read work without a request to do so:		
Yes/ Sometimes	100%(10)	67%(6)
No	0%(0)	33%(3)
10. Do assignments as soon as they are given:		
Yes/ Sometimes	100%(10)	67%(6)
No	0%(0)	33%(3)
11. Spend adequate time on doing assignments:		
Yes/ Sometimes	90%(9)	67%(6)
No	10%(1)	33%(3)

AI = Average Intelligence Group
MMD = Mildly Mentally Disabled Group

Attributions and Learning Behaviors

Attributions of success and failure.

Subjects' reports with respect to their attributions and learning behaviors are presented in Table 11. According to the self-reports of the subjects, a majority of the AI subjects (n=9) and MMD subjects (n=7) would attribute their success to effort, ability and skill. One AI subject (subject No. 8) and two MMD subjects (subjects No. 11 and 19) would attribute their success to both effort, ablity, skill and luck. No one in either groups reported the reason for success to be merely luck.

All the AI subjects attributed the reason for failure to be due to a lack of ability, skill or effort. The AI subjects did not indicate the involvement of luck in their failure. The MMD subjects were divided in their attributions of failure. Four MMD subjects (subjects No. 11, 13, 14 and 18) considered the reason for failure to be lack of ability, skill and effort. Another four (subjects No. 12, 15, 16 and 17) considered the lack of luck to be the major reason for their failure. One subject (subject No. 19) suggested that failure was the result of a lack of effort, ability, skill as well as luck.

Learning behaviors.

According to the interviews with the AI subjects, they could generally be described as "active learners". When faced with problems, the majority (n=9) reported that they would look for alternative solutions. All of the AI subjects perceived themselves as persons motivated to learn new information that would be of interest to them. The majority of AI subjects (n=9) indicated that they would spend time learning things which would not be examined. When given assignments to do, all of them indicated that they would tackle the assignments immediately. The majority (n=9) expressed the desire to spend adequate time on doing the assignments. All ten AI subjects reported that they would proof-read their work without a request to do so. All of them described themselves as persons with confidence. Some of them (n=6) reported that they would not be put off by poor marks in an examination or give up, but others reported that

they (n=4) would. Nine AI subjects indicated that they would worry about their examination and test results even when they had prepared adequately.

According to the reports of the MMD subjects, if they were required to solve problems, most of them (n=7) would not look for alternate ways to tackle the problems. Only two MMD subjects said they would explore alternative solutions. In learning situations, all the MMD subjects said they were motivated to learn information. Five MMD subjects indicated that they would not spend time on learning information which would not be examined, while four would. If given an assignment to do, two-thirds of MMD subjects (n=6) responded that they would do the assignment immediately, spend an adequate amount of time on the assignment, and proof-read the assignment even when they were not requested to do so. The other one-third (n=3) responded that they would not do so.

In the affective area, eight MMD subjects (except subject No. 16) described themselves as persons with confidence. However, all of them indicated that they would worry about examination results even when they were adequately prepared. Seven of the MMD subjects indicated that they would be put off by poor marks and would give up quite easily.

The Results of the Investigator's Assessment

After reviewing the think-aloud procedures (Appendix E), the subjects in each group were individually assessed with Instrument No. 3: Investigator Assessment (Appendix D). During the assessment sessions, the twelve tasks in the Instrument were administered to each subject by the investigator and the subjects were required to perform the tasks. During and after the task performance, the subjects were required to verbalize what they were thinking. Summaries of the assessment results are presented in Tables 12 to 16 and discussed below under the topics of: a) memory strategies and, b) learning behaviors. Results of Instrument No. 3 were calculated using the same method as that of Instrument No. 2. The results of the subjects' verbal reports were

rated by another person. The interrater reliability was calculated to be 97.6% agreement for the AI group and 95.8% agreement for the MMD group (Table 12).

Memory Strategies

Awareness and use of memory strategies.

Table 13 presents the percentage and frequency of memory strategies of both groups of subjects as assessed by the investigator. Assessment results indicated that all the AI subjects reported an awareness or use of memory strategies. The total frequency of strategies the subjects in this group reported using for the twelve tasks was 184 with a mean frequency of 18.4. All ten subjects described the use of more than one memory strategy for each task.

The total frequency of strategies the MMD subjects reported utilizing, as measured by Instrument No. 3, was 134 with a mean frequency of 14.9. Seven subjects described the use of more than one strategy for each task. Two subjects (subjects No. 12 and 13) mentioned using only one strategy in remembering each task.

Strategies used more often.

The strategies that the AI subjects described in the assessment sessions were mostly elaborative rehearsal (f=65), visual imagery (f=63) and maintenance rehearsal (f=49). Mnemonics (f=7) were mentioned by three subjects (subjects No. 2, 3, and 5). Other strategies and regulatory behaviors which subjects frequently reported are summarized in Table 14. Examples of such behaviors are checking the results of memorizing (f=16), paying attention, and concentrating on understanding the task to facilitate memory (f=9). The regulatory strategy related to obtaining assistance from others was reported only once by subject No. 2. It was observed that all AI subjects tackled the tasks as soon as the tasks were presented to them. AI subjects also indicated that this behavior would help them remember the information.

TABLE 12

Investigator Assessment: Interrater Reliability
(N: AI = 10, MMD = 9)

Strategy	Frequency Agreement AI	Frequency Agreement MMD	Frequency Disagreement AI	Frequency Disagreement MMD	Interrater Reliability AI	Interrater Reliability MMD
Memory Strategies						
MR	49	60	1	0		
ER	65	20	0	0		
VI	62	53	1	3		
MS	7	0	0	0		
Other Strategies						
Atten.	7	18	2	2		
Assist.	1	0	0	2		
Immed.	0	0	0	0		
Check	15	7	1	0		
					97.6%	95.8%
TOTAL:	**206**	**158**	**5**	**7**	**96.8%**	

AI = Average Intelligence Group
MMD = Mildly Mentally Disabled Group
MR = Maintenance Rehearsal Strategy
ER = Elaborative Rehearsal Strategy
MS = Mnemonics
Atten. = Attentional factors
Assist. = Obtain assistance
Immed. = Perform the tasks immediately
Check = Check results

TABLE 13

Investigator Assessment: Percentage, Frequency of Memory Strategies and Percentage of Correct Responses

(N: AI = 10, MMD = 9)

Subject	Strategy: Percentage (Frequency) MR	ER	VI	MS	Correct Response
Average Intelligence Group (AI)					
No. 1*	56%(10)	0%(0)	44%(8)	0%(0)	60%
No. 2*	10%(2)	55%(11)	30%(6)	5%(1)	87%
No. 3*	29%(5)	12%(2)	41%(7)	18%(3)	70%
No. 4*	45%(9)	15%(3)	40%(8)	0%(0)	76%
No. 5*	19%(4)	29%(6)	38%(8)	14%(3)	81%
No. 6*	47%(7)	40%(6)	13%(2)	0%(0)	67%
No. 7*	40%(6)	33%(5)	27%(4)	0%(0)	70%
No. 8*	14%(3)	40%(9)	46%(10)	0%(0)	87%
No. 9*	11%(2)	63%(12)	26%(5)	0%(0)	89%
No.10*	6%(1)	65%(11)	29%(5)	0%(0)	91%
Mean %:	**27%**	**35%**	**34%**	**4%**	**77.8%**
Frequency:	**49**	**65**	**63**	**7**	

Total frequency of strategies: 184

Mean frequency of strategies for the 12 tasks: 18.4

Mean type of strategies each subject used: 3.2

% of agreement of correct responses = $\frac{113}{113 + 7} \times 100\%$

= 94.16%

Mildly Mentally Disabled Group (MMD)					
No.11*	53%(8)	14%(2)	33%(5)	0%(0)	43%
No.12	55%(6)	0%(0)	45%(5)	0%(0)	46%
No.13	63%(5)	25%(2)	12%(1)	0%(0)	70%
No.14*	59%(10)	12%(2)	29%(5)	0%(0)	58%
No.15*	29%(5)	18%(3)	53%(9)	0%(0)	59%
No.16*	47%(7)	13%(2)	40%(6)	0%(0)	73%
No.17*	54%(7)	15%(2)	31%(4)	0%(0)	53%
No.18*	10%(2)	35%(7)	55%(11)	0%(0)	74%
No.19*	56%(10)	0%(0)	44%(8)	0%(0)	74%
Mean %:	**45%**	**15%**	**40%**	**0%**	**60%**
Frequency:	**60**	**20**	**54**	**0**	

Total frequency of strategies: 134

Mean frequency of strategies for the 12 tasks: 14.9

Mean type of strategies each subject used: 2.8

% of agreement of correct responses = $\frac{95}{95 + 13} \times 100\%$

= 87.96%

MR = Maintenance Rehearsal Strategy
ER = Elaborative Rehearsal Strategy
VI = Visual Imagery
MS = Mnemonics
* = Subject who used more than one strategy for a task

The MMD subjects reported using maintenance rehearsal (f=60) and visual imagery (f=54) most frequently in the assessment sessions. Another strategy described by the MMD group was elaborative rehearsal (f=20). During the assessment sessions, the MMD subjects did not indicate the use of mnemonics. Other regulatory strategies MMD subjects mentioned during the assessment sessions included paying attention, concentrating (f=20) and checking the results of memory efforts (f=7).

Types of strategies.

The types of memory strategies mentioned by the AI group (see Table 13) included maintenance rehearsal, elaborative rehearsal, visual imagery, and mnemonics. Three of the AI subjects (subjects No. 2, 3, and 5) indicated the use of all four types of memory strategies. One subject (subject No. 1) did not mention the use of elaborative rehearsal or mnemonics while six other subjects did not describe utilizing mnemonics. During the assessment sessions, all ten AI subjects indicated that they used other regulatory strategies to assist their recall of information. Examples of such strategies can be found in Table 14 and Appendix G. The most preferred type of regulatory strategy was to check the results of memorizing (f=16). Some of the AI subjects also tried paying attention, concentrating and understanding the information provided (f=9). Perhaps due to the one-on-one assessment situation, only one AI subject (subject No. 2) suggested obtaining help from others to help him/her perform the memory tasks. It was observed that when the AI subjects were given the memory tasks, they tended to perform the tasks immediately.

The types of memory strategies the MMD group described in the assessment sessions included maintenance rehearsal, elaborative rehearsal, and visual imagery. Mnemonics were not mentioned by the MMD subjects. Seven MMD subjects reported using maintenance rehearsal, elaborative rehearsal, and visual imagery. Two MMD subjects (subjects No. 12 and 19) did not mention elaborative rehearsal. All nine subjects did not describe the use of mnemonics. Other regulatory strategies were also reported (Table 14). The

MMD subjects preferred regulatory strategies such as paying attention (f=20) and checking results (f=7). One MMD subject (subject No. 12) reported that he/she would obtain assistance from others to perform the tasks.

Types of strategy and correct responses.

When the subjects performed the tasks in Instrument No. 3, their verbal responses were evaluated, the number of correct responses were recorded and a percentage of correct response was calculated (Table 13). Another rater was consulted in regards to the specifications of the task and marking system to ensure a reliable criterion and evaluation of the correct responses. The correctness and acceptability of the verbal responses was assessed by another person, and interrater reliability was calculated using the point by point system previously described. Percentage agreements of 94% for the AI group and 88% for the MMD group were obtained.

The mean percentage of correct responses obtained for the AI group was 77.8%, with a range of 60% to 91%. Five AI subjects (subjects No. 2, 5, 8, 9, and 10) obtained greater than 80% accuracy in their responses. Among these five subjects, four reported using elaborative rehearsal and visual imagery for a combined total of 85% to 94% when they were asked to perform memory tasks. The other subject (subject No. 5) mentioned using a combined total of 81% elaborative rehearsal, visual imagery and mnemonics. Maintenance rehearsal was less frequently described by these five subjects. The other five subjects (subjects No. 1, 3, 4, 6, and 7) who obtained less than 80% accuracy in their responses tended to use more maintenance rehearsal and visual imagery (a combined total of 60% to 100% for the two strategies). Subjects who obtained less than 80% accuracy on memory task performance reported utilizing elaborative rehearsal and mnemonics for a combined total ranging between 0% to 40%.

TABLE 14

Investigator Assessment: Other Strategies
(N: AI =10, MMD =9)

Subject	Other Strategies: Percentage (Frequency) A	OA	DI	CR	Total f
Average Intelligence Group (AI)					
No.1	83%(5)	0%(0)	0%(0)	17%(1)	6
No.2	0%(0)	25%(1)	0%(0)	75%(3)	4
No.3	0%(0)	0%(0)	0%(0)	100%(1)	1
No.4	0%(1)	0%(0)	0%(0)	80%(4)	5
No.5	33%(1)	0%(0)	0%(0)	67%(2)	3
No.6	100%(1)	0%(0)	0%(0)	0%(0)	1
No.7	25%(1)	0%(0)	0%(0)	75%(3)	4
No.8	0%(0)	0%(0)	0%(0)	100%(1)	1
No.9	0%(0)	0%(0)	0%(0)	0%(0)	0
No.10	0%(0)	0%(0)	0%(0)	100%(1)	1
Mean %	**26.1%**	**2.5%**	**0%**	**61.4%**	
Total f	**9**	**0**	**16**	**26**	
Mean f	**0.9**	**0.1**	**0**	**1.6**	**2.6**
Mildly Mentally Disabled Group (MMD)					
No.11	67%(4)	0%(0)	0%(0)	32%(2)	6
No.12	67%(4)	33%(2)	0%(0)	0%(0)	6
No.13	86%(6)	0%(0)	0%(0)	14%(1)	7
No.14	67%(2)	0%(0)	0%(0)	33%(1)	3
No.15	100%(1)	0%(0)	0%(0)	0%(0)	1
No.16	0%(0)	0%(0)	0%(0)	100%(2)	2
No.17	100%(2)	0%(0)	0%(0)	0%(0)	2
No.18	100%(1)	0%(0)	0%(0)	0%(0)	1
No.19	0%(0)	0%(0)	0%(0)	100%(1)	1
Mean %	**65.2%**	**3.7%**	**0%**	**31.1%**	
Total f	**20**	**2**	**0**	**7**	**29**
Mean f	**2.2**	**0.2**	**0**	**0.8**	**3.3**

A = Attention, concentration and understanding
OA = Obtain assistance from others or use cues
DI = Do the task immediately
CR = Check results of memorizing

The MMD group was less accurate than the AI group in their responses. The mean percentage of correct responses of the MMD group was 60% with a range of 43% to 74%. Four MMD subjects (subjects No. 13, 16, 18, and 19) obtained over 70% of the correct responses. Five MMD subjects (subjects No. 11, 12, 14, 15, and 17) obtained less that 60% of the correct responses. There was a difference in strategy-use between the group of MMD subjects who obtained greater than 70% accuracy and the group who obtained less than 60% accuracy. The pattern of strategy preference appears to be less consistent than the pattern obtained from AI subjects. In general, the MMD group reported a tendency to use more maintenance rehearsal and visual imagery for a total ranging between 65% to 100%. 0% to 25% of the memory tasks were reported using elaborative rehearsal. Mnemonics were not mentioned by the MMD group. The results of the AI subjects who obtained less than 80% accuracy were similar to those obtained by the MMD group.

Types of memory strategies and the nature of the tasks.

According to the assessment results, both AI and MMD groups indicated the use of different memory strategies to memorize different types of information. Table 15 summarizes the types and percentage of memory strategies the subjects reported using when given different types of information to recall.

AI subjects described the application of different memory strategies when remembering different lists. When recalling a list of colours and non-meaningful numbers, AI subjects indicated using visual imagery (37% to 38%) or maintenance rehearsal (28% to 44%). If the lists were names or numbers to be grouped, AI subjects indicated a tendency to use maintenance rehearsal (36% to 42%) or elaborative rehearsal (33% to 36%). When reading a factual story, they described using elaborative rehearsal and visual imagery (40%) most frequently. When reading a descriptive story or listening to a factual story, they

indicated a preference for elaborative rehearsal (42% to 44%) to recall the main points. To help recall a descriptive story they had heard, AI subjects reported using visual imagery (60%). When memorizing verbal instructions and written procedures, they reported applying elaborative rehearsal and visual imagery (35% to 41%). Mnemonics were minimally utilized by the AI group.

When the MMD subjects had to remember a list of colours, they reported using visual imagery most often (47%). When memorizing lists of names, numbers or categorizable items, MMD subjects mentioned the application of maintenance rehearsal 43% to 70% of the time. When memorizing main points heard or read from factual stories, maintenance rehearsal (42% to 46%) and visual imagery (45% to 50%) were preferred. When remembering main points heard or read from descriptive stories, they reported using visual imagery more often (50% to 64%). When following verbal instructions, they expressed the preference for maintenance rehearsal (50%) and visual imagery (33%). When they had to follow a written procedure, they preferred to use visual imagery (67%). None of the MMD subjects indicated they would utilize mnemonics to memorize the tasks.

In general, both groups reported a tendency to use maintenance rehearsal when the nature of the tasks required rote memory (e.g., to recall lists of colours, names, and non-meaningful numbers). However, there was an apparent difference between the groups in the strategy reported when the tasks demanded deeper level of thinking and processing (e.g., to categorize, to extract and recall main points, to follow procedures and instructions). In this situation, the AI group alternated its preference to elaborative rehearsal, while the MMD group maintained a preference for maintenance rehearsal and visual imagery.

TABLE 15

Investigator Assessment: Types of Memory Strategies
(N: AI=10, MMD=9)

Nature of Memory Task		Memory Strategy MR	ER	VI	MS
Average Intelligence Group (AI)					
List of colours in correct serial order		28%	17%	38%	17%
List of names		42%	33%	17%	8%
Series of non-meaningful numbers		44%	19%	37%	0%
Numbers to be grouped		36%	36%	28%	0%
Items to be categorized	(a)	27%	33%	27%	13%
	(b)	20%	53%	27%	0%
Main points read from factual story		20%	40%	40%	0%
Main points read from descriptive story		29%	42%	29%	0%
Main points heard from factual story		28%	44%	28%	0%
Main points heard from descriptive story		7%	26%	60%	7%
Verbal instructions		24%	41%	35%	0%
Procedure read from a book		20%	40%	40%	0%
Mildly Mentally Disabled Group					
List of colours in correct serial order		33%	20%	47%	0%
List of names		62%	15%	23%	0%
Series of non-meaningful numbers		70%	10%	20%	0%
Numbers to be grouped		62%	15%	23%	0%
Items to be categorized	(a)	50%	20%	30%	0%
	(b)	43%	21%	36%	0%
Main points read from factual story		42%	8%	50%	0%
Main points read from descriptive story		30%	20%	50%	0%
Main points heard from factual story		46%	9%	45%	0%
Main points heard from descriptive story		27%	9%	64%	0%
Verbal instructions		50%	17%	33%	0%
Procedure read from a book		22%	11%	67%	0%

MR = Maintenance Rehearsal Strategy
ER = Elaborative Rehearsal Strategy
VI = Visual Imagery
MS = Mnemonics

Nature of the tasks and correct responses.

The percentage and the rank order of correct responses with respect to the nature of memory tasks is presented in Table 16. The AI group obtained a mean correct response of 77.8%, with a range of 56.8% to 93%. The MMD group obtained a mean of 60% with a range of 29.6% to 90%.

The overall pattern of correct responses for the two groups was similar. The AI group obtained higher percentages of correct responses when required to remember a list of foods which could be categorized (93%) and to follow verbal instructions (92%). The MMD group obtained the highest score (90%) when required to remember a list of colours. Similar to its AI counterpart, the MMD group's scores were higher when required to remember a list of categorizable food items (80.9%), main points read from a descriptive story (72.2%), and to follow verbal instructions (72.2%).

With respect to the lower scores, the pattern of the AI and the MMD groups were again similar. Both groups obtained lower scores when required to remember the main points heard from a descriptive or a factual story. Lower scores were obtained by AI and MMD subjects when they were asked to remember a series of non-meaningful numbers. In addition, the MMD group obtained a low score when required to remember a written procedure. This result may have been attributed to the MMD subjects' lower reading level.

In general, the AI group obtained 13% to 35% more correct responses than the MMD group, except when they had to remember a list of colours in correct serial order. When compared with the AI group, the MMD group obtained a much lower percentage of correct response when required to recall the following: procedures read from a book (-34.6%), grouped numbers (-31.2%) and a series of non-meaningful numbers (-27.2%).

TABLE 16

Investigator Assessment: Percentage and Rank Order of Correct Responses by Nature of Tasks
(N: AI=10, MMD=9)

Nature of Memory Task	% of Correct Responses (Rank Order) AI	MMD	Difference (MMD-AI)
List of colours in correct serial order	82.5(6)	90(1)	+7.5%
List of names	74.3(9)	60.2(7)	-14.1%
Series of non-meaningful numbers	56.8(12)	29.6(12)	-27.2%
Numbers to be grouped	86.8(3)	55.6(8)	-31.2%
Items to be categorized			
(a)	93(1)	80.9(2)	-12.1%
(b)	84(5)	68.9(5)	-15.1%
Main points read from factual story	76.5(7)	61.4(6)	-15.1%
Main points read from descriptive story	85(4)	72.2(3)	-12.8%
Main points heard from factual story	58(11)	42.2(10)	-15.8%
Main points heard from descriptive story	64(10)	43.3(9)	-20.7%
Verbal instructions	92.5(2)	72.2(3)	-20.3%
Procedure read from a book	76.5(7)	41.9(11)	-34.6%
Mean:	**77.8**	**60**	

Integration of the Results of the Three Instruments

Memory Strategies

Awareness and use of memory strategies.

Results of the Instruments 1, 2, and 3 are integrated and presented in Table 17. According to the teachers' predictions, subjects' self-reports and investigator's assessment, both groups of subjects indicated awareness and use of memory strategies. The teachers predicted that the subjects would use various memory strategies on different occasions. While responding to tasks presented in Instrument No. 2, the subjects described to the investigator the memory strategies and other regulatory strategies they would use to help them remember information. While performing assessment tasks in Instrument No. 3, the subjects indicated the use of memory strategies and other regulatory strategies which helped them remember the tasks. There is a difference among the frequencies of strategies in the three methods of assessment: prediction by teachers, self-report by the subjects and assessment by the investigator (see Tables 4, 8 and 18). For the AI group, the highest frequency of strategies was noted when the subjects were assessed by the investigator (f=184, mean=18.4). The frequency of strategies was the lowest according to the teachers' reports (f=127, mean=12.7). The MMD group also obtained the lowest frequency of strategies according to the predictions of their teachers (f=110, mean=12.2). The MMD group obtained the highest frequency of strategy use under the self-report condition (f=137. mean=15.2). Under the investigator's assessment condition, MMD subjects indicated a frequency of 134 (mean=14.9), which was similar to the frequency obtained in the self-reporting condition.

TABLE 17

Summary of Overall Results: Memory Strategies by Subject
(N: AI = 10, MMD = 9)

Subject	Strategy	Instrument No.1 % (f)	No.2 % (f)	No.3 % (f)	Mean % A	B
Average Intelligence Group (AI)						
No. 1:	MR	17%(2)	35%(6)	*56%(10)	36%	45%
	ER	0%(0)	24%(4)	0%(0)	8%	12%
	VI	*75%(9)	*41%(7)	44%(8)	53%	43%
	MS	8%(1)	0%(0)	0%(0)	3%	0%
No. 2:	MR	29%(5)	14%(2)	10%(2)	18%	12%
	ER	12%(2)	*72%(10)	*55%(11)	46%	63%
	VI	*35%(6)	7%(1)	30%(6)	24%	19%
	MS	24%(4)	7%(1)	5%(1)	12%	6%
No. 3:	MR	31%(5)	0%(0)	29%(5)	20%	15%
	ER	13%(2)	31%(6)	12%(2)	19%	21%
	VI	*50%(8)	*53%(10)	*41%(7)	48%	47%
	MS	6%(1)	16%(3)	18%(3)	13%	17%
No. 4:	MR	*46%(5)	*57%(8)	*45%(9)	49%	51%
	ER	18%(2)	7%(1)	15%(3)	13%	11%
	VI	36%(4)	22%(3)	40%(8)	33%	31%
	MS	0%(0)	14%(2)	0%(0)	5%	7%
No. 5:	MR	8%(1)	18%(3)	19%(4)	15%	19%
	ER	8%(1)	18%(3)	29%(6)	18%	23%
	VI	*50%(6)	*47%(8)	*38%(8)	45%	42%
	MS	34%(4)	17%(3)	14%(3)	22%	16%
No. 6:	MR	*46%(5)	*58%(7)	*47%(7)	50%	52%
	ER	18%(2)	33%(4)	40%(6)	30%	37%
	VI	18%(2)	9%(1)	13%(2)	14%	11%
	MS	18%(2)	0%(0)	0%(0	6%	0%
No. 7:	MR	17%(2)	*53%(8)	*40%(6)	36%	46%
	ER	9%(1)	20%(3)	33%(5)	21%	26%
	VI	*58%(7)	20%(3)	27%(4)	35%	24%
	MS	16%(2)	7%(1)	0%(0)	8%	4%
No. 8:	MR	25%(3)	33%(5)	14%(3)	24%	24%
	ER	9%(1)	*40%(6)	40%(9)	30%	40%

	VI	*50%(6)	27%(4)	*46%(10)	41%	36%
	MS	16%(2)	0%(0)	0%(0)	5%	0%
No. 9:	MR	*33%(4)	27%(4)	11%(2)	24%	19%
	ER	9%(1)	*60%(9)	*63%(12)	44%	61%
	VI	*33%(4)	13%(2)	26%(5)	24%	20%
	MS	25%(3)	0%(0)	0%(0)	8%	0%
No. 10:	MR	25%(3)	7%(1)	6%(1)	13%	6%
	ER	17%(2)	*73%(11)	*65%(11)	51%	69%
	VI	*33%(4)	13%(2)	29%(5)	25%	21%
	MS	25%(3)	7%(1)	0%(0)	11%	4%

Percentage (frequency) agreement between results of Instruments No. 1* & No. 2* : 50% (5)

Percentage (frequency) agreement between results of Instruments No. 1* & No. 3* : 50% (5)

Percentage (frequency) agreement between results of Instruments No. 2* & No. 3* : 80% (8)

Percentage (frequency) agreement between results of Instruments No. 1*, 2* & 3* : 40% (4)

Mildly Mentally Disabled Group (MMD)

No. 11:	MR	*100%(12)	*75%(9)	*53%(8)	76%	64%
	ER	0%(0)	25%(3)	14%(2)	13%	19%
	VI	0%(0)	0%(0)	33%(5)	11%	17%
	MS	0%(0)	0%(0)	0%(0)	0%	0%
No. 12:	MR	*100%(12)	*92%(11)	*55%(6)	82%	73%
	ER	0%(0)	8%(1)	0%(0)	3%	4%
	VI	0%(0)	0%(0)	45%(5)	15%	23%
	MS	0%(0)	0%(0)	0%(0)	0%	0%
No. 13:	MR	*100%(12)	*62%(8)	*63%(5)	75%	62%
	ER	0%(0)	15%(2)	25%(2)	13%	20%
	VI	0%(0)	23%(3)	12%(1)	12%	18%
	MS	0%(0)	0%(0)	0%(0)	0%	0%
No. 14:	MR	*100%(12)	*73%(11)	*59%(10)	77%	66%
	ER	0%(0)	7%(1)	12%(2)	7%	10%
	VI	0%(0)	20%(3)	29%(5)	16%	24%
	MS	0%(0)	0%(0)	0%(0)	0%	0%
No. 15:	MR	*100%(12)	38%(6)	29%(5)	56%	34%
	ER	0%(0)	6%(1)	18%(3)	8%	12%
	VI	0%(0)	*56%(9)	*53%(9)	36%	54%
	MS	0%(0)	0%(0)	0%(0)	0%	0%

No. 16:	MR	*100%(12)	26%(5)	*47%(7)	58%	36%
	ER	0%(0)	26%(5)	13%(2)	13%	20%
	VI	0%(0)	*42%(8)	40%(6)	27%	41%
	MS	0%(0)	6%(1)	0%(0)	2%	3%
No. 17:	MR	*100%(12)	*57%(8)	*54%(7)	70%	55%
	ER	0%(0)	29%(4)	15%(2)	15%	22%
	VI	0%(0)	14%(2)	31%(4)	15%	23%
	MS	0%(0)	0%(0)	0%(0)	0%	0%
No. 18:	MR	*100%(12)	32%(6)	10%(2)	47%	21%
	ER	0%(0)	10%(2)	35%(7)	15%	23%
	VI	0%(0)	*58%(11)	*55%(11)	38%	56%
	MS	0%(0)	0%(0)	0%(0)	0%	0%
No. 19:	MR	*86%(12)	*47%(8)	*56%(10)	63%	51%
	ER	14%(2)	6%(1)	0%(0)	2%	3%
	VI	0%(0)	*47%(8)	44%(8)	30%	46%
	MS	0%(0)	0%(0)	0%(0)	5%	0%

Percentage (frequency) agreement between results of Instruments No. 1* & No. 2* :	**61% (5.5)**
Percentage (frequency) agreement between results of Instruments No. 1* & No. 3* :	**78% (7)**
Percentage (frequency) agreement between results of Instruments No. 2* & No. 3* :	**89% (8)**
Percentage (frequency) agreement between results of Instruments No. 1*, 2* & 3* :	**69% (6)**

MR = Maintenance Rehearsal Strategy
ER = Elaborative Rehearsal Strategy
VI = Visual Imagery
MS = Mnemonics
Mean % A = Mean % of teachers' perception (Instrument No. 1), subjects' self-report (Instrument No. 2), and assessment results (Instrument No.3)
Mean % B = Mean % of subjects' self-report (Instrument No. 2) and investigator assessment results (Instrument No. 3)
f = Frequency of strategy
* = The most frequent strategy observed, reported or assessed by the Instruments

Preferred types of strategies.

As expected, the results indicated similarities and differences between the teachers' predictions, subjects' self-reports, and the assessment results with respect to preferred types of memory strategies. For the purposes of this study, the strategies most frequently observed, or reported using for the memory tasks were considered "preferred strategies". Table 17 identifies the preferred strategies by each individual subject in each instrument. Table 18 summarizes the preferred strategies for the AI group and MMD group in each instrument. If two strategies were given equal preference by a subject, the frequency was divided, and each strategy was given 0.5. For example, in Table 17, subject number 9 had equal preference for both maintenance rehearsal and visual imagery, 0.5 was allocated to each of these two strategies when calculating the total frequency of preferred strategies. The following discussion pertaining to preferred strategies, focuses on group preference summarized in Table 18.

The teachers predicted visual imagery to be the preferred memory strategy for the AI group (f=7.5). The next preferred strategy predicted by AI teachers was maintenance rehearsal (f=2.5). The subjects reported a preference rate which was different from their teachers' predictions. The AI group reported an almost equal preference for elaborative rehearsal (f=4), visual imagery (f=3), and maintenance rehearsal (f=3). No subject in this group indicated the preference for mnemonics. Results of the investigator assessment were similar to the subjects' self-reports. Assessment results indicated that the AI group had almost equal preference for maintenance rehearsal (f=4), elaborative rehearsal (f=3) and visual imagery (f=3). No subject in this group indicated during the assessment sessions the usage or preference for mnemonics. This assessment result pertaining to mnemonics corresponds with those of teachers' predictions and subjects' self-reports.

TABLE 18

Summary of Overall Results: Preferred Memory Strategies
(N: AI=10, MMD=9)

Instrument	Group	Preferred Strategy % (frequency) MR	ER	VI	MS
No.1	AI	25%(2.5)	0%(0)	75%(7.5)	0%(0)
	MMD	100%(9)	0%(0)	0%(0)	0%(0)
No.2	AI	30%(3)	0%(4)	30%(3)	0%(0)
	MMD	61%(5.5)	0%(0)	39%(3.5)	0%(0)
No.3	AI	40%(4)	30%(3)	30%(3)	0%(0)
	MMD	61%(5.5)	0%(0)	39%(3.5)	0%(0)

Preferred strategy = Memory strategy most frequently observed, reported or used by the group
AI = Average intelligence group
MMD = Mildly mentally disabled group
MR = Maintenance rehearsal strategy
ER = Elaborative rehearsal strategy
VI = Visual imagery
MS = Mnemonics strategy
Frequency = Frequency of preferred strategy

The teachers predicted that the MMD group would prefer maintenance rehearsal (f=9) for all the memory tasks. In the subjects' self-reports, the MMD group reported a preference for maintenance rehearsal (f=5.5) and visual imagery (f=3.5). This group did not express a preference for elaborative rehearsal or mnemonics. The overall results of the investigator's assessment were identical to the subjects' self-reports, with maintenance rehearsal (f=5.5) reported as the most preferred strategy and visual imagery as the second preferred strategy (f=3.5). Similar to the subjects' self-reports, no preference for elaborative rehearsal or mnemonics was expressed during the assessment sessions.

An integration of the results for Instruments No.1, 2, and 3 suggests that the AI group was likely to apply maintenance rehearsal, elaborative rehearsal as well as visual imagery to remember information. The MMD group clearly preferred maintenance rehearsal as a strategy. The second preference for the MMD group was visual imagery. It appears that the MMD group did not mention elaborative rehearsal or mnemonics very often. Results indicate that both groups did not show a preference for mnemonics, and even if an individual reported using mnemonics, he/she indicated only first-letter mnemonics.

Types of memory strategies and nature of the tasks.

Table 19 integrates the results of Instruments 1, 2, and 3 with regard to preferred memory strategies within the context of different learning situations. A discussion of the relationship between the preferred types of memory strategies and the nature of the memory tasks is presented as follows.

1. **List of colours in correct serial order** -- The teachers predicted that the AI group had a preference for visual imagery (55%) while the AI group reported its' preference to be maintenance rehearsal (43%). In contrast to the teachers' prediction, the group reported the use of visual imagery only 7% of the time. The investigator's assessment results corresponded with the teachers' perceptions as well as the subjects' reports, indicating the preferred

strategies to be visual imagery (38%) and maintenance rehearsal (28%).

The teachers predicted the MMD group to use only maintenance rehearsal to remember a list of colours. The MMD subjects themselves reported a preference for maintenance rehearsal (58%) as well as visual imagery (33%). The assessment results were similar to the subjects' reports with maintenance rehearsal (33%) and visual imagery (47%) indicated as the preferred strategies.

2. **List of names** -- When the task was to remember first names, teachers predicted the AI group would use elaborative rehearsal (30%) and visual imagery (30%) more frequently than other strategies. Maintenance rehearsal and mnemonics were expected to be used 20% of the time by the AI group. The AI group reported the most frequently used strategy for the first name memory task to be elaborative rehearsal (70%). The AI group indicated the preference for maintenance rehearsal and visual imagery 10% to 20% of the time. In contrast to the subjects' self-reports, when performing the assessment tasks with the investigator, the AI group reported utilizing maintenance rehearsal (42%) and elaborative rehearsal (33%) more often. In general, there was an indication in the results that when the AI subjects were asked to remember a list of first names, they preferred an elaborative rehearsal strategy, supplemented with maintenance rehearsal and visual imagery.

The teachers perceived that the MMD group would have a preference for maintenance rehearsal (100%) when asked to remember a list of first names. The MMD group reported a preference for maintenance rehearsal (40%), elaborative rehearsal (30%), and visual imagery (30%). During the assessment sessions, the MMD group indicated a preference for maintenance rehearsal (62%) although they reported using elaborative rehearsal (15%) and visual imagery (23%) as well. Results obtained from the three instruments consistently indicated that maintenance rehearsal (40% to 100%) was preferred by the MMD group to memorize a list of names.

TABLE 19

Summary of Overall Results: Memory Strategies and Nature of Tasks
(N: AI = 10, MMD = 9)

Nature of Memory Task	Instrument No.1 AI	MMD	No.2 AI	MMD	No.3 AI	MMD
List of colours in correct serial order						
MR	18%	100%	43%	58%	28%	33%
ER	18%	0%	21%	0%	17%	20%
VI	55%	0%	7%	33%	38%	47%
MS	9%	0%	29%	9%	17%	0%
	f=11	**f=9**	**f=14**	**f=12**	**f=18**	**f=15**
List of names						
MR	20%	100%	10%	40%	42%	62%
ER	30%	0%	70%	30%	33%	15%
VI	30%	0%	20%	30%	17%	23%
MS	20%	0%	0%	0%	8%	0%
	f=10	**f=9**	**f=10**	**f=10**	**f=12**	**f=13**
Series of non-meaningful numbers						
MR	70%	100%	55%	82%	44%	70%
ER	0%	0%	27%	9%	19%	10%
VI	30%	0%	18%	9%	37%	20%
MS	0%	0%	0%	0%	0%	0%
	f=10	**f=9**	**f=11**	**f=11**	**f=16**	**f=10**
Numbers to be grouped						
MR	70%	100%	50%	67%	36%	62%
ER	0%	0%	30%	8%	36%	15%
VI	20%	0%	20%	25%	28%	23%
MS	10%	0%	0%	0%	0%	0%
	f=10	**f=9**	**f=10**	**f=12**	**f=14**	**f=13**
Items to be categorized (a)						
MR	27%	90%	8%	58%	27%	50%
ER	9%	10%	46%	17%	33%	20%
VI	37%	0%	38%	25%	27%	30%
MS	27%	0%	8%	0%	13%	0%
	f=11	**f=10**	**f=13**	**f=12**	**f=15**	**f=10**
Items to be categorized (b)						
MR	21%	100%	15%	16%	20%	43%
ER	29%	0%	43%	42%	53%	21%
VI	29%	0%	21%	42%	27%	36%
MS	21%	0%	21%	0%	0%	0%
	f=14	**f=9**	**f=14**	**f=12**	**f=15**	**f=14**

Main points read from factual story						
MR	34%	90%	21%	73%	20%	42%
ER	11%	10%	50%	0%	40%	8%
VI	33%	0%	29%	27%	40%	50%
MS	22%	0%	0%	0%	0%	0%
	f=9	**f=10**	**f=14**	**f=11**	**f=15**	**f=12**
Main points read from descriptive story						
MR	0%	100%	29%	33%	29%	30%
ER	0%	0%	29%	25%	42%	20%
VI	100%	0%	42%	42%	29%	50%
MS	0%	0%	0%	0%	0%	0%
	f=9	**f=9**	**f=14**	**f=12**	**f=14**	**f=0**
Main points heard from factual story						
MR	30%	100%	23%	64%	28%	46%
ER	10%	0%	31%	18%	44%	9%
VI	40%	0%	38%	18%	28%	45%
MS	20%	0%	8%	0%	0%	0%
	f=10	**f=9**	**f=13**	**f=11**	**f=18**	**f=11**
Main points heard from descriptive story						
MR	20%	100%	28%	36%	7%	27%
ER	0%	0%	36%	18%	26%	9%
VI	80%	0%	36%	46%	60%	64%
MS	0%	0%	0%	0%	7%	0%
	f=10	**f=9**	**f=14**	**f=11**	**f=15**	**f=11**
Verbal instructions						
MR	9%	100%	38%	42%	24%	50%
ER	0%	0%	38%	8%	41%	17%
VI	55%	0%	24%	50%	35%	33%
MS	36%	0%	0%	0%	0%	0%
	f=11	**f=9**	**f=13**	**f=12**	**f=17**	**f=6**
Procedure read from a book						
MR	17%	100%	31%	64%	20%	22%
ER	17%	0%	31%	0%	40%	11%
VI	33%	0%	23%	36%	40%	67%
MS	33%	0%	15%	0%	0%	0%
	f=12	**f=9**	**f=13**	**f=11**	**f=15**	**f=9**

AI = Average Intelligence Group
MMD = Mildly Mentally Disabled Group
MR = Maintenance Rehearsal Strategy
ER = Elaborative Rehearsal Strategy
VI = Visual Imagery
MS = Mnemonics
Instrument No. 1 = Teachers' observations and prediction
Instrument No. 2 = Subjects' self-report
nstrument No. 3 = Investigator's assessment
f = Total frequency of strategies

3. **Numbers** -- The teachers expected maintenance rehearsal (70%) to be the AI group's preferred strategy for memorizing non-meaningful numbers or numbers to be grouped. The AI group reported its preferred strategy for the tasks to be maintenance rehearsal (50% to 55%), but they also indicated the usage of elaborative rehearsal (27% to 30%) and visual imagery (18% to 20%). Results of the investigator's assessment were similar to the subjects' self-reports. During the assessment sessions, the AI group preferred maintenance rehearsal (36% to 44%), although they also reported using elaborative rehearsal (19% to 36%) and visual imagery (28% to 37%). The AI group did not indicate any preference for mnemonics.

The teachers of the MMD group expected the group to use only maintenance rehearsal (100%) to remember numbers. The MMD group also reported a preference for maintenance rehearsal (67% to 82%), suggesting that they would also apply elaborative rehearsal (8% to 9%) and visual imagery (9% to 25%). Consistent with the MMD subjects' reports, they indicated a preference for maintenance rehearsal (62% to 72%), while reported using elaborative rehearsal (10% to 15%), as well as visual imagery (20% to 23%) when performing memory tasks. The MMD group did not mention the use of mnemonics.

The results consistently indicated that the subjects in both groups preferred maintenance rehearsal (36% to 100%) to memorize a series of non-meaningful numbers and numbers which could be grouped. Both AI and MMD subjects seldom reported utilizing mnemonics to help them remember numbers.

4. **Items which can be categorized** -- When the AI group was presented with a list of food or daily objects to remember, the teachers predicted the group to have almost equal preference for maintenance rehearsal (21% to 27%), elaborative rehearsal (9% to 29%), visual imagery (29% to 37%) and mnemonics (21% to 27%). In the subjects' self-reports, the AI group reported the preference for elaborative rehearsal (43% to 46%) and visual imagery (21% to 38%). The AI group also reported the use of maintenance

rehearsal (8% to 15%) and mnemonics (8% to 21%). When presented with assessment tasks by the investigator, AI subjects indicated a preference for elaborative rehearsal (33% to 53%). AI subjects also reported utilizing maintenance rehearsal (20% to 27%) and visual imagery (27%) to remember items which could be categorized.

Teachers of the MMD group expected the group to apply maintenance rehearsal (90% to 100%) to memorize items which could be categorized. The MMD subjects also reported the preference for maintenance rehearsal (58%), but they indicated they would also use elaborative rehearsal (17% to 42%) and visual imagery (25% to 42%) when tackling a task. However, when the MMD subjects performed the assessment tasks, the most preferred strategies were maintenance rehearsal (43% to 50%) and visual imagery (30% to 36%).

Results of Instruments 1, 2, and 3 suggested that the AI group would likely use all the four memory strategies to help them remember items which could be categorized. The MMD group frequently reported the use of maintenance rehearsal and visual imagery for the tasks.

5. **Main points in a factual story** -- When the AI group was presented with a factual story to read or to listen to, the teachers expected the group to apply maintenance rehearsal (30% to 34%) and visual imagery (33% to 40%). The AI subjects reported their preference to be elaborative rehearsal (31% to 50%) and visual imagery (29% to 38%), although they indicated they would use maintenance rehearsal (21% to 23%) in addition to the other two strategies. The assessment results were similar to those of the subjects' self-reports. When performing the assessment tasks, the AI subjects preferred elaborative rehearsal (40%) and visual imagery (40%) to remember a factual story they had read. The AI group preferred elaborative rehearsal (44%) when asked to recall a factual story they had heard.

Teachers expected 90% to 100% of the MMD subjects to use maintenance rehearsal to remember a factual story read or heard. The MMD subjects themselves reported a preference for maintenance rehearsal (64% to

73%) and visual imagery (18% to 27%) for the task. While performing the assessment tasks, they equally preferred maintenance rehearsal (42% to 46%) and visual imagery (45% to 50%).

To sum up, the results suggest that the AI group would likely apply maintenance rehearsal, elaborative rehearsal and visual imagery, while the MMD group would likely apply maintenance rehearsal and visual imagery when required to memorize the main points in a factual story.

6. **Main points in a descriptive story** -- When the AI group was presented visually or auditorily with a descriptive story, the teachers expected the group to use visual imagery (80% to 100%) to remember the story. The AI subjects reported their preference to be visual imagery (36% to 42%) as well as elaborative rehearsal (29% to 36%). The AI group mentioned using maintenance rehearsal (28% to 29%) slightly less frequently. During the assessment sessions, the AI group reported using different strategies when the descriptive story was presented to them visually or auditorily. AI subjects preferred elaborative rehearsal (42%) when asked to memorize a descriptive story they had read. When they were requested to remember a descriptive story they had heard, they preferred visual imagery (60%).

Teachers of the MMD group predicted that the MMD subjects would prefer maintenance rehearsal (100%) to memorize the descriptive story they had read or heard. The MMD group reported a preference for visual imagery (42% to 46%) and maintenance rehearsal (33% to 36%) when memorizing the main points in a descriptive story. The MMD subjects' self-reports were consistent with the investigator's assessment results. While performing the assessment tasks, they described the use of visual imagery (50% to 64%) and maintenance rehearsal (27% to 30%) to help them remember the main points in a descriptive story they had read or heard.

In general, results indicate that the AI group preferred elaborative rehearsal and visual imagery when required to remember the main points in a descriptive story. Their preference for a particular strategy was slightly affected

by whether the story was presented to them auditorily or visually. The MMD group, on the other hand, did not seem to be affected by the way the story was presented. They preferred visual imagery and maintenance rehearsal when remembering the main points in a descriptive story they had read or heard.

7. **Instructions and procedures** -- When the AI group was asked to remember verbal instructions or written procedures, the teachers expected the group's preference to be visual imagery (33% to 55%) and mnemonics (33% to 36%). When the AI group reported the memory strategies used to remember instructions and procedures, they indicated the preference for maintenance rehearsal and elaborative rehearsal (both 31% to 38%). Sometimes, AI subjects reported applying visual imagery (23% to 24%) to assist them in the tasks. During the investigator's assessment, the AI group indicated a preference for elaborative rehearsal (40% to 41%) and visual imagery (35% to 40%). Maintenance rehearsal (20% to 24%) was less frequently mentioned.

The teachers perceived the MMD group to use only maintenance rehearsal when asked to memorize procedures and instructions. When being interviewed and asked to verbally describe their strategies, the MMD subjects reported a preference for maintenance rehearsal (42% to 64%) as well as visual imagery (36% to 50%). During assessment, the MMD subjects indicated a higher preference for visual imagery (33% to 67%) and a slightly lower preference for maintenance rehearsal (22% to 50%) when asked to complete the tasks.

In general, results suggest that the AI group would prefer maintenance rehearsal, elaborative rehearsal and visual imagery when asked to recall information from verbal instructions and written procedures. MMD subjects preferred maintenance rehearsal and visual imagery when they were required to remember verbal instructions and written procedures.

Other regulatory strategies.

An integration of the results presented in Table 8 and Table 13 indicates that the two groups might use different regulatory strategies on different

occasions. While performing the tasks in Instrument No. 2, both AI and MMD groups reported a preference for asking assistance from others (58.7% and 62% respectively), in addition to the memory strategies they had suggested. All subjects also reminded themselves to pay attention, concentrate and understand the information (AI group: 15.9%, MMD group: 20%). Subjects from both groups indicated checking the results of memorization (AI group: 20.8%, MMD group: 10%). When being assessed with tasks in Instrument No. 3, the AI group preferred to check the results of memorization (61.4%), in addition to utilizing other memory strategies. The AI subjects reported that they helped themselves recall by paying attention, concentrating and trying to understand the information (26.1%). Similar to the AI group, the MMD group identified the need to pay attention, concentrate and understand, as well as check the results of memorization. However, the MMD subjects' first preference for regulatory strategies was paying attention, concentrating and understanding (65%). Checking results of memorization (31%) was accorded the second preference for the MMD group.

Agreement of the Results of the Three Instruments

The percentage agreement of the preferred strategies indicated in the three instruments was calculated and presented in Table 17. The percentage agreement was calculated by using the point by point method described in Chapter 3.

A comparison of teachers' predictions (Instrument No. 1) and subjects' self-reports (Instrument No. 2) pertaining to preferred strategies (Table 17) indicated a 50% agreement with the AI group and 61% agreement with the MMD group. When the results of the teachers' predictions (Instrument No. 1) and investigator's assessment (Instruments No. 3) were compared, the agreement for the most frequently observed strategies was 50% for the AI group and 78% for the MMD group. When the results of subjects' self-reports (Instrument No. 2) and investigator's assessment (Instruments No. 3) were

compared in terms of the subjects' preferred strategies, the AI group had an 80% agreement, while the MMD group had an 89% agreement. When the results of the teachers' predictions, subjects' self-reports and investigator's assessment (Instruments No. 1, 2, and 3) were compared, there was a 40% agreement for the AI group, and a 67% agreement for the MMD group.

It is apparent that Instruments No. 2 and No. 3 have the highest percentage agreement among the Instruments. This higher agreement may possibly be due to the fact that both instruments were administered by the same investigator, and both instruments required the subjects to verbally report memory strategies usage. The prompts provided on both occasions were consistent, in attempts to elicit verbal responses. In addition, the subjects may have learned what responses were expected from them.

The highest percentage agreement within the groups was obtained from the results for the MMD group. A possible reason for the higher percentage agreement for the MMD group may be the limitation of the range of memory strategies reported by this group. The AI group has a lower percentage agreement with the results perhaps because they had a greater capacity to utilize a variety of memory strategies including maintenance rehearsal, elaborative rehearsal, visual imagery and mnemonics.

Attributions and Learning Behaviors

Instruments No. 1 and No. 2 explored the subjects' attributions of success and failure, and some learning behaviors as perceived by the teachers and the subjects themselves. An integration of the results of the two instruments presented in Tables 6 and 11 gives a general outline of the subjects' attributions and learning behaviors. A percentage agreement between teachers' predictions and subjects' self-reports was calculated by using the point by point method. A summary of the percentage agreement is presented in Table 20.

TABLE 20

Agreement Between Teacher Perceptions & Subject Self-Reports: Attribution and Learning Behaviors
(N: AI=10, MMD=9)

Behaviors	Perceptions % (No. of Subjects)			
	Agree		Disagree	
	AI	MMD	AI	MMD
Attributions				
1. Reason for success:				
-Effort/skill/ability	90%(9)	11%(1)	10%(1)	78%(7)
-Chance/luck	0%(0)	11%(1)		
-Both	0%(0)	0%(0)		
2. Reason for failure:				
-Lack ability/skill/effort	100%(10)	44%(4)	0%(0)	56%(5)
-Lack luck	0%(0)	0%(0)		
-Lack both	0%(0)	0%(0)		
Learning Behaviors				
3. Look for alternate ways to solve problems:				
-Yes/ Sometimes	90%(9)	11%(1)	10%(1)	56%(5)
-No	0%(0)	33%(3)		
4. Motivated to learn interesting new information:				
-Yes/ Sometimes	90%(9)	89%(8)	10%(1)	11%(1)
-No	0%(0)	0%(0)		
5. Spend time to learn things which will not be asked:				
-Yes/ Sometimes	60%(6)	11%(1)	30%(3)	33%(3)
-No	10%(1)	56%(5)		
6. Put off by poor mark and give up easily:				
-Yes/ Sometimes	10%(1)	44%(4)	50%(5)	56%(5)
-No	40%(4)	0%(0)		
7. Worry about results even when s/he studies hard:				
-Yes/ Sometimes	80%(8)	78%(7)	20%(2)	22%(2)
-No	0%(0)	0%(0)		

8. Described as a person with confidence:				
-Yes/ Sometimes	100%(10)	56%(5)	0%(0)	33%(3)
-No	0%(0)	11%(1)		
9. Proof read work without a request to do so:				
-Yes/ Sometimes	80%(8)	11%(1)	20%(2)	67%(6)
-No	0%(0)	22%(2)		
10. Do assignments as soon as they are given:				
-Yes/ Sometimes	100%(10)	56%(5)	0%(0)	11%(1)
-No	0%(0)	33%(3)		
11. Spend adequate time on doing assignments:				
-Yes/ Sometimes	80%(8)	33%(3)	20%(2)	45%(4)
-No	0%(0)	22%(2)		

AI = Average Intelligence Group
MMD = Mildly Mentally Disabled Group

Attributions of success and failure.

Both teachers' observations (see Table 6) and subjects' self-reports (Table 11) suggested that the AI group attributed its success to effort, ability and skill (100% and 90% respectively in Instruments No. 1 and 2). The teachers and AI subjects perceived that AI group would attribute its failure to the lack of ability, skill and effort (100% and 100% respectively). With the MMD group, the teachers' perceptions and the subjects self-reports were not as consistent. The teachers perceived that 78% of the MMD subjects would attribute their success to chance and luck, while the MMD subjects reported that their reasons for success were mainly due to effort, ability and skill (78%) and partly due to both effort and luck (22%). The teachers perceived the MMD subjects (100%) would attribute their failure to the lack of ability, skill and effort, however, the MMD subjects' explanations for failure were lack of ability, skill and effort (40%) as well as lack of luck (40%). The possible explanations for the discrepancy relevant to the MMD group are: a) the MMD subjects tried to provide answers which helped themselves look good; and b) the teachers had lower expectations for the MMD subjects.

In the area of attribution of success and failure, the percentage of agreement between teachers' perceptions and subjects' self-reports was 90% to 100% for the AI group and 22% to 44% for MMD group (Table 20).

Learning behaviors.

The perceptions of the teachers and the self-reports of the AI subjects on learning behavior were very consistent. According to the descriptions of the teachers and the subjects themselves (see Tables 6 and 11), the AI subjects could be considered as "active learners". When required to solve problems, the majority of AI subjects (9 to 10) would look for alternate ways to solve the problems. The AI subjects (8 to 10) were motivated to learn new information which was interesting. They (6 to 9) reported that they would spend time learning information which would not be asked on the examinations. When AI subjects were given assignments to do, all of them indicated that they would do

the assignment as soon as possible. The majority of AI subjects (n=9) would spend adequate time completing the assignments. Eight to ten of the AI subjects indicated that they would proof-read their work without a request to do so. In the affective area, all the AI subjects were described by the teachers and themselves as "persons with confidence". The majority of them (6 to 7) would not be put off by poor marks in examinations nor would they give up. However, nine of them indicated that they would worry about their examination results, even when they had prepared adequately. With the MMD group, it appeared that the subjects rated themselves lower in problem solving and confidence, and higher in learning behaviors. When the MMD subjects were required to solve problems, the teachers perceived five of them to look for alternate ways to solve the problems; however, only two of the MMD subjects indicated that they would explore other alternate solutions. The teachers described all nine MMD subjects as "persons with confidence" which was comparable to the MMD subjects' description of themselves. Eight of the MMD subjects considered themselves to be "persons with confidence". The teachers predicted that seven of the MMD subjects would worry about examination results even when they had studied adequately, and they would give up easily when confronted by poor marks. All the MMD subjects on the other hand, reported that they worried about examination results. In learning situations, the subjects' reports were more favourable of themselves. All the MMD subjects told the investigator that they were motivated to learn information that was interesting, in contrast to the teachers' indication that eight of the MMD subjects were motivated to learn new items. Teachers perceived that nine of the MMD subjects would not spend time learning information not asked on the examinations, while five of the MMD subjects admitted that they would not spend time on learning extraneous information. When given assignments to do, six of the MMD subjects reported they would do the assignment as soon as they were given it, while the teachers predicted that five of the subjects would do so. Six of the MMD subjects reported they would spend adequate time on

doing the assignments, but the teachers indicated that four of the subjects would do so. Both the MMD subjects and the teachers stated that the majority of the MMD (n=7; n=6) would not proof-read the assignments if they were not requested to do so.

The percentage agreement between teachers' perceptions and subjects' perceptions in the area of learning behavior is 50% to 100% for the AI group and 33% to 89% for MMD group (see Table 20).

To sum up, the teachers' perceptions and the subjects' self-reports were more consistent for the AI group than the MMD group (Table 20). The possible reasons for the inconsistency in the MMD group are: a) the MMD subjects had less confidence in themselves due to previous experiences of failure and they thereby rated themselves lower in the areas of self-confidence and problem solving skills; b) the MMD subjects may have attempted to impress the interviewer, thereby rating themselves higher in the area of learning behaviors.

Conclusions

Results for the Instruments No. 1, 2, and 3 adopted for this study appear to compliment and supplement each other. Using multiple assessment procedures would likely avoid the effects of teachers' under-estimation of the students. A multiple assessment approach may also guard against the risk of the students providing socially desirable answers. Multiple assessments also render a more complete analysis, rather than recording results hindered by test apprehension. To obtain a more global picture of the initial state of memory strategies of the subjects, it appears that the multiple assessment procedure is feasible. The teachers' report would provide relatively accurate information on subjects' attributions and learning behaviors. Subjects' self-reports and assessment results would provide more information on cognitive and metacognitive strategies which are likely to be tapped by using the think-aloud procedures. In addition, results would tend to have a better agreement if the tasks were administered by the same individual, preferably someone the subject is familiar with in a natural setting.

CHAPTER V
DISCUSSION OF RESULTS AND CONCLUSIONS

Introduction

The present study was designed to seek answers to specific questions regarding: (a) the initial state of memory strategies of mildly mentally disabled adolescents; (b) the difference in memory strategies, attributions of success and failure, and learning behaviors between mildly mentally disabled adolescents (MMD) and children with average intelligence (AI); and (c) the feasibility of the multiple assessment approach adopted for this study.

Nineteen subjects, ten in the AI group and nine in the MMD group, were identified according to the selection criteria. Informal multiple assessment procedures consisting of a teacher questionnaire, memory tasks for subjects' self-reports and investigator assessment were administered to the subjects. The assessment techniques incorporated the teachers' observations and predictions, the subjects' self-perceptions, and the investigator's assessment. The conclusions compiled from the results of the data analysis presented in the preceding chapter will be discussed for each research question established in Chapter I. This chapter will conclude with discussion of the parameters and limitations of the study. A discussion of the implications of the findings will also be found in this chapter.

Discussion of Results and Conclusions

Questions Related to the Initial State of Memory Strategies

Question 1: Do MMD subjects use memory strategies when they learn new information?

Discussion and Conclusions

The results of the teachers' questionnaire, subjects' self-reports and investigator's assessment revealed that the MMD subjects were aware of and used memory strategies when learning new information. The classroom teachers predicted that the MMD subjects would apply memory strategies in

different learning situations. While responding to memory tasks presented in Instrument No. 2, the MMD subjects orally described to the investigator various strategies they would adopt to perform the tasks. When the MMD subjects were assessed with the memory tasks in Instrument No. 3, they reported the use of preferred memory strategies. The frequency of strategies reported was not consistent across the different methods of assessment (teachers' observations and predictions, subjects' self-reports, and investigator's assessment). The total number of strategies the MMD subjects verbalized in the self-reports (137) and in the investigator's assessment (134) were similar; however, the teachers predicted the least frequency of strategy usage (110). This result may suggest that the MMD subjects were capable of and consistent in the reporting of strategies they were aware of or used. In contrast, the teachers appeared to under-estimate the subjects' capabilities for memory strategies. The possible reasons for the under-estimation may be: (a) the memory process, like other cognitive processes, cannot be overtly observed and accurately recorded without a degree of subjectivity; (b) the students may not be able to explicitly demonstrate their cognitive abilities and processes; and (c) the teachers may have subconsciously or consciously adopted lower expectations from the MMD students, compared to their AI counterparts.

Educational Implications

To obtain a global outlook of students' initial strategy, it is important to supplement observational data with measures such as subject self-reporting and assessment procedures implementing the "think-aloud" procedure. To avoid the negative effect inherent in under-estimating student capabilities, and in an effort to adopt a more realistic picture of students with mental disabilities, it is essential to determine the basal level of the students. Basal levels may be obtained by conducting multiple assessments and incorporating observations before any actual intervention takes place. The "test-teach-test" procedure, described in Chapter 2, may be useful for identifying the initial learning baseline, designing a program of studies and evaluating the outcomes of intervention.

Question 2: Which types of memory strategies (maintenance rehearsal, elaborative rehearsal, visual imagery, mnemonics) do MMD subjects use more often?

Discussion and Conclusions

Although the frequency of strategies was not entirely consistent in the three assessment methods, the types of strategies observed by the teachers, reported by the subjects and assessed by the investigator were extremely consistent. In this particular study, the MMD subjects mainly preferred maintenance rehearsal and visual imagery as memory strategies. A preference for elaborative rehearsal was indicated, but this strategy was reported to a lesser extent by MMD subjects. Mnemonics were rarely mentioned by the MMD group. MMD subjects had a knowledge of four types of memory strategies. These strategies are discussed in the order of greater to lesser frequency of use.

Maintenance rehearsal.

The most preferred strategy of the MMD subjects was maintenance rehearsal. It is apparent that the MMD subjects in this study did not display a rehearsal deficit as hypothesized by Ellis (1970), since they reported the knowledge and use of rehearsal strategy. However, the rehearsal strategy that MMD subjects applied basically consisted of rote rehearsal rather than the more sophisticated elaborative rehearsal. In all instances, the majority of the MMD subjects tended to rote repeat the entire task without actively building connections between incoming information or prior knowledge. This inability to interconnect learning experiences may be one of the factors which accounted for the MMD group's lower memory performance.

The possible reasons for the MMD subjects to prefer maintenance rehearsal may be: (a) that the MMD subjects were restricted in the range of strategies and the ability to select the appropriate strategy, although their ability to rehearse appeared to be intact (Justice, 1985); (b) MMD subjects may have adopted the "surface approach" described by Biggs (1987). According to

Biggs, students using the surface approach tended to view school learning as an "unavoidable" task, and therefore tried to get through it with minimal effort, by relying on rote learning strategies for which extra work or higher level cognitive reasoning was not required. The description evolving from students using the surface approach correlates with the strategy usage and learning behaviors of the MMD subjects in this study. As exemplified in this study, the MMD subjects were less likely to spend time learning materials which would not be examined. MMD subjects were also less likely to proof-read work without a request to do so, or to spend adequate time on completing an assignment. When adopting a memory strategy, MMD subjects relied on maintenance rehearsal, which does not involve higher level reasoning.

Visual Imagery.

The second most frequently preferred strategy reported by the MMD subjects was visual imagery which is a non-verbal representation system. The MMD subjects appeared to use visual imagery spontaneously, yet consistently. In the self-reports of MMD subjects, they repeatedly suggested visual imagery for the memory tasks, and during the assessment sessions, they discussed the use of it. As suggested by Whitman (1990) and Pressley (1990), due to the lower language and reading abilities of MMD students, they may prefer to rely on pictures for meaning, thereby recalling via visual cues, rather than verbal cues. This may explain why visual imagery was preferred by MMD subjects.

Elaborative rehearsal.

Some of the MMD subjects described the application of elaborative rehearsal strategies in their self-reports. The elaborative rehearsal strategies that the MMD subjects described were mainly concrete association and grouping. Some examples of concrete association are associating the information to be remembered to familiar objects; associating colours to be remembered to objects which have the same colours, and associating objects to be remembered with their use. Examples of grouping are grouping food according to food group and grouping words according to easy ones and

difficult ones. Although the MMD subjects had a knowledge of elaborative rehearsal, they did not report using it actively during the assessment sessions. The lesser frequency of elaborative rehearsal usage corresponds with other studies. Thomas (1984) suggested that disabled persons displayed a verbal knowledge of strategies, but they did not consistently use the strategies nor did they attain a high degree of proficiency in using those particular strategies.

The MMD subjects in this study appeared to complete the tasks using a minimal degree of mental effort. This was achieved by relying on more simple strategies such as maintenance rehearsal and visual imagery and avoiding the more complex strategies such as elaborative rehearsal and mnemonics. This finding is consistent with Schneider's suggestion (1989) that the lack of spontaneous use of elaborative rehearsal and other complex strategies may be partially due to the enormous mental effort required to employ such strategies.

Mnemonics.

While performing the memory tasks in this study, only one MMD subject indicated the knowledge and use of first-letter mnemonics. The other eight MMD subjects appeared to be unaware of mnemonic strategies. The possible explanation for this result may be that the MMD subjects were not taught the mnemonic strategy. If the MMD students were not taught the strategy, it is unlikely they would learn and apply the strategy by themselves.

Memory strategy and the nature of the tasks.

It is evident that the nature of the memory tasks in Instruments 1, 2, and 3 did not have much of an effect on the types of strategies the MMD subjects employed. MMD subjects indicated a tendency to apply maintenance rehearsal and visual imagery to all tasks regardless of the nature of the tasks. This finding may be related to the MMD persons' limited range of strategies, cognitive rigidity, lack of abilities or lack of experiences to generate other strategies. Whatever the possibilities are, they should be investigated.

It is clearly indicated by the results in this study that the MMD students, like other students, found it easier to recall while using memory strategies.

Whether the information be straight forward lists, meaningful and practical knowledge, or more difficult information, the inclusion of memory strategies greatly improved the chances for mental retention. Perhaps partially due to MMD students' lower reading level (approximately grade 2), it is evident that they preferred lower level processing strategies. As a result, the MMD group's performance and percentage of accurate responses were relatively better with lower level processing tasks, than higher level processing tasks.

To summarize, the MMD subjects appeared to use maintenance rehearsal and visual imagery more often, regardless of the nature of the tasks. MMD subjects also tended to use elaborative rehearsal to a lesser extent, and they seldom used mnemonics.

Educational Implications

Findings of this study suggested that the MMD students' range of strategies was limited. The MMD students' range of cognitive and metacognitive strategies should be expanded to include more complex strategies such as elaborative rehearsal and mnemonic strategies. Research indicated that MMD students were capable of learning these strategies. As suggested by Justice (1985), training in the use of more complex strategies may result in increased memory monitoring by disabled children. The MMD students should be taught not just the knowledge of the strategies, but also the usage and control of the strategies. Strategy instructional programs such as the Strategies Program for Effective Learning/ Thinking (SPELT, Mulcahy et al., 1987) may be considered to facilitate spontaneous usage, generalization and transfer of strategies.

Findings of this study also indicated that MMD students were less motivated to learn new information and to utilize more complex strategies. One of the ways to motivate them to learn and to use strategies is by making strategy learning interesting. As pointed out by Kunzinger and Witryol (cited in Schneider & Pressley, 1989), motivational stimulation of tasks affects students who normally prefer passive rehearsal strategies. By motivating students to

utilize various strategies, students may be more inclined to pay attention to tasks that are interesting and relevant, thereby increasing the chances that students would build connections between incoming information and prior knowledge.

The results of this study suggested that MMD students learn better using the visual mode. The MMD students' strength in visual learning should be maximized, and the importance of visual imagery in their strategy instructional program should be stressed. As pointed out by Whitman (1990) and Pressley (1990), because of the MMD students' language deficiencies, they are more likely to mediate their responses through visual, rather than verbal cues. Teachers should emphasize the use of visual cueing techniques when teaching MMD students during the early stages of strategy instruction.

Question 3: What other strategies do MMD subjects use when they remember new information?

Discussion and Conclusions

Justice (1985) suggested that persons with mild mental disabilities possess some beliefs and knowledge about memory without necessarily having the ability to regulate them effectively. This study provides evidence consistent with Justice's findings.

The MMD subjects in this study indicated a degree of beliefs and knowledge about memory. They had previous knowledge of some types of memory strategies and they also appeared to have developed some beliefs about memory. An awareness of the effects of variables such as interference and retention interval was recognized and demonstrated by MMD subjects, as components which may alter memory performance. MMD subjects indicated that they would perform a task immediately after it was given to them, suggesting that they were aware that interruption in their learned routine may interfere with the future recall of the information.

The MMD subjects regulated their strategic behaviors. MMD subjects exhibited monitoring procedures for their current state of memory by reported the use of regulatory strategies. The regulatory strategies described by the MMD subjects included paying attention, concentrating, obtaining help from others, and checking memory efforts. Their first preference for regulatory strategies involved paying attention, concentrating and understanding (65%), while checking memory efforts (31%) was accorded a second preference. However, consistent with Justice's (1985) findings, the MMD subjects did not seem to regulate their memory effort effectively, which in turn affected the efficiency of their memory performance. In this study, MMD subjects obtained a lower average (mean = 60%, range = 43% to 74%) accuracy than the AI subjects (mean = 77.8%, range = 60% to 91%) when assessed with memory tasks in Instrument No. 3.

Educational Implications

The MMD subjects exhibited a knowledge and usage of some regulatory behaviors; however, they did not regulate their strategies effectively. The implication from this finding is to train MMD students in self-regulation. Further discussion of self-regulation and implications will be outlined in the following section relating to the differences between MMD and AI subjects.

Question 4: Are there any differences in the initial state of memory strategies between MMD and AI subjects?

Discussion and Conclusions

Two aspects of cognitive monitoring are frequently addressed by researchers in cognitive psychology: knowledge about cognitive and metacognitive processes, and the ability to monitor and regulate those processes. Knowledge about cognitive and metacognitive processes encompasses the knowledge of person variables, task variables, and strategy variables (Flavell, 1984). Regulatory processes include planning, monitoring and checking. According to Whitman (1990), there is a distinction between

knowledge and understanding which is important within an instructional program. To know a memory strategy, the subject should be able to verbalize specific strategic information about a task, make verbal comparisons between tasks, and articulate decision rules. To fully understand a memory task involves the appropriate utilization of verbally represented knowledge within specific performance situations. To self-regulate, individuals must learn to use verbal information (rules) to direct (govern) their behaviors. Results of Instrument No. 2 and No. 3 in this study provided some information on the similarities and differences between MMD and AI subjects in their knowledge and regulation of the memory behaviors.

Knowledge about memory processes.

1. **Knowledge of person variables** -- Knowledge of person variables refers to one's knowledge and beliefs about human beings as cognitive processors (Flavell, 1984). Results of this study suggest that both AI and MMD subjects possessed some knowledge about the limitations of their memory system and recall readiness.

Both MMD and AI subjects demonstrated the knowledge of memory system limitations. They were aware of the effects of certain variables of memory performance such as interference and retention interval. Many of the subjects involved in this study suggested that they would perform the memory tasks immediately after they were assigned to avoid forgetting the information. It appears that the MMD subjects relied more heavily on tackling the task immediately to avoid memory failure, than their AI counterparts. This high frequency of immediacy in task performance may suggest that the MMD subjects had less confidence in their own memory ability.

There was a difference between AI and MMD groups with relation to the concept of recall readiness. When Instrument No. 3 was administered, the subjects were asked to study the memory tasks until they could recall them well. It was observed that the AI subjects took more time to study the information, re-read the information, continuously monitor the state of the to-be-

remembered items, and evaluate when the items had been thoroughly learned, before they indicated that they were ready to recall. In contrast, the MMD subjects usually repeated the materials once or twice and reported that they were ready to recall, without checking whether the items had been thoroughly remembered. This difference may be due to: a) the AI subjects having a better concept of when they were ready to recall; b) the AI subjects being more efficient in checking and regulating their learning behaviors; c) the AI subjects possessing a greater motivation to achieve better results. These suggestions may partly explain why the AI subjects performed memory tasks better than MMD subjects.

2. **Knowledge of task variables** -- Knowledge of task variables is concerned with the nature of the information in a cognitive task and the nature of the task demands (Flavell, 1984). Via knowledge of task variables, one learns that various tasks may require different processing procedures and strategies. Results of this study indicated that the AI subjects were more sensitive to task variables than were the MMD subjects. AI subjects modified their strategies to different task demands, while the MMD subjects tended to apply the same two strategies (maintenance rehearsal and visual imagery) to all tasks regardless of the task demand. The results obtained in this study are not entirely consistent with those of Forrest-Pressley and Waller's study (1984) which examined children's ability to modify their reading behaviour for different reading purposes. Forrest-Pressley and Waller (1984) suggested that children's ability to adjust strategies in response to various task demands increased with mental age and reading ability. In their study, third-grade poor and average readers seemed to use the same strategy in the same way regardless of the task instruction. In contrast, better readers and chronologically older readers displayed differences in their comprehension performance and differentiated between task demands to a greater extent. In this study, the mental ages of both AI and MMD groups were matched, but the language and reading levels of the two groups were not the same. As identified by the teachers, most of

the MMD subjects had a grade two reading level which was significantly lower than that of the AI subjects. As some of the memory tasks in this study required the subjects to read a short story, remember the main points in the story, and think-aloud the strategies to recall the main points, the lower reading level and comprehension ability, rather than mental age, may be one of many factors affecting the MMD subjects' ability to understand the task demand. Brown (1980) suggested that learners may become more strategic in processing information when they encounter difficulties. Despite Brown's (1980) suggestion, it is speculated that if the text is too difficult for the learners, a discontinuation of strategy use would be the result due to a high level frustration.

3. **Knowledge of strategy variables** -- Knowledge of strategy variables refers to one's knowledge about the nature and usefulness of strategies which can be utilized to achieve various cognitive goals (Flavell, 1984). In this regard, it is noteworthy to point out that Paris, Lipson and Wixson (1983) had described strategies as having components of "both skills and will" (p.304). Unless learners desire to attain a goal and believe that they can accomplish a particular goal, it is unlikely that they will spend the time and energy it requires to activate relevant knowledge, engage in monitoring the process and invoke strategies to achieve cognition (Garner, 1987). The learner's goals of attaining knowledge are therefore important in the learning process. The key concepts in the definition of strategy variables therefore include knowledge of strategies and achievement of goals.

Regarding the knowledge of strategies, as previously discussed, the MMD subjects appeared to be knowledgable in a limited variety of memory strategies. MMD subjects reported the application of relatively simple strategies such as maintenance rehearsal and visual imagery, to perform all tasks. The AI subjects, on the other hand, seemed to generate more strategies and reported a greater range of strategy than the MMD subjects.

With regard to the achievement of goals, the MMD subjects appeared to be less concerned about the usefulness of their strategies to achieve their goals, whereas the AI subjects tended to adjust their strategies in an attempt to achieve their goals. This finding may be related to Biggs' model of student learning (1987). Biggs proposed three major types of motive-strategy combination, where each combination defines a distinct approach of learning. These three approaches of learning are surface, deep, and achieving. Each approach consists of a motive component and a strategy component. The surface motive is instrumental with the main intention to meet requirements with minimal effort. The surface strategy is reproductive and often associated with rote learning. The deep approach is intrinsic; striving to actualize one's interests. The deep strategy is meaningful since it extracts a maximum degree of meaning by obtaining a breadth of knowledge and inter-relating incoming information with previous relevant knowledge. The achievement motive is to publicly manifest one's excellence. The achieving strategy is based on organizing one's time and work space. According to Biggs, all these major approaches lead to qualitatively different learning outcomes. Students who employ the deep approach usually display the greatest metalearning capability, while those who take the surface approach often show little or minimal metacognitive awareness. Students who employ the achievement approach display a learning capacity which falls between the deep approach and surface approach. Biggs' study (1987) also indicated a correlation between locus of control, academic performance, and approaches to learning. It was reported that the deep approach scores were consistent with an internal locus of control and a good academic performance. The surface approach scores were associated with an external locus of control and poor academic performance.

As previously discussed, the MMD subjects may have adopted the surface approach. The strategies that the MMD group reported were reproductive in nature and were often associated with rote learning. MMD subjects appeared to attempt the tasks with a minimal effort, by describing rote

learning strategies for which extra work or reasoning was not required. In contrast, the AI subjects were described by the teachers and themselves as "active learners" thereby possessing a greater motivation to learn. It is not evident from this study which approaches the AI subjects had adopted; however, the strategies that they reported utilizing were more related to deep strategies which placed an emphasis on meaning and integration with previous knowledge.

In summation, it is likely that the differences between the AI and MMD groups in the strategy variables were not only related to knowledge of strategies, level of abilities, motivational levels and strategy control, but also to the learning approaches that each subject adopted (e.g., surface, deep, and achievement approaches proposed by Biggs, 1987).

Self-regulation.

Both groups of subjects demonstrated some knowledge about regulatory strategies such as paying attention, concentrating, and understanding new information. While thinking-aloud the strategies for the tasks in Instruments No. 2 and No. 3, subjects in both groups repeatedly reported that they paid attention and concentrated on the most important information in an attempt to assist their recall. It is interesting to note that the MMD group accorded a higher priority to paying attention than did the AI group (AI group: 15.9% to 26.1%; MMD group: 20% to 65%). Perhaps the MMD subjects were more sensitive and aware of the necessity for the concentration process since they were more easily distracted, whereas the AI subjects were less aware of the process as it had become automatic in their learning repertoire. As a result, the MMD subjects frequently reported that they had to concentrate on the tasks.

Brown (1983) suggested planning, monitoring, and checking as important regulatory processes. In this study, an indication of the planning process of the subjects was not available; however, both groups demonstrated an involvement in the monitoring and checking processes. MMD and AI groups

both reported checking the results of their memory efforts, but the AI group indicated a higher frequency for monitoring and checking than did the MMD group (AI group: 20.8% to 61.4%, MMD group: 10% to 31%). This result may be an indication that the AI subjects were more involved in metacognition. They were more likely to execute the strategy, continuously monitor the state of the to-be-remembered items, and evaluate the items when they had been thoroughly learned.

Whitman (1990) suggested that persons with mental disabilities tended to look to others for assistance because of inability to self-regulate their behaviors. Results of this study indicated that both the AI and MMD groups had a strong reliance on external devices to assist in recalling information. Both groups suggested asking parents, teachers or friends to remind them of the memory tasks, writing the information down, or relying on external retrieval cues. The results seem to indicate that this dependency on external devices was not inextricably linked to mental disabilities, but may be related to mental age. As well, it may have been a result caused by a variety of potentially remediable factors such as inappropriate demands by others, overprotective parents, and the absence of experiences that foster decision-making.

Relationship between strategy knowledge and strategy use.

As previously pointed out, this study did not directly measure the subjects' use of strategy, but rather, indirectly inferred the subjects' use of strategy from the teachers' and the subjects' reports. For the purpose of this study, "strategy use" refers to strategy observed, predicted, or reported using. It appears that there was a relationship between strategy knowledge and strategy use with both groups of subjects. The MMD group reported a preference for maintenance rehearsal (61%) and visual imagery (39%) for most of the tasks in Instrument No. 2. When performing the tasks in Instrument No. 3, MMD subjects reported executing these two strategies. Similarly, the AI subjects reported using the three strategies they recommended as effective strategies in Instrument No. 2 when asked to perform the memory tasks in

Instrument No. 3. This result corresponds with Brown's studies (1976) which indicate that some children actually executed the strategy they judged to be effective.

To summarize, the results of this study agree with the limited data available on the regulatory abilities of children with mental disabilities, indicating that even without training, they show low-level monitoring of the current state of memory. Results also suggest that the AI group was likely to be more skillful in complex behavior, including selecting an appropriate strategy, executing the strategy, continuously monitoring the state of the to-be-remembered items, and evaluating the process after the items had been thoroughly learned.

Relationship between reported strategy use and performance.

In this study, although both AI and MMD groups reported using strategies, their performance in memory tasks was varied and the MMD subjects were less accurate in recalling the information than were the AI subjects. The possible explanations for the difference in performance may be: a) the MMD subjects were less aware that they had to make sense of what they read or heard; b) the MMD subjects tended to maintain a decoding emphasis on reading and listening, and were less aware of the need and value of strategies for monitoring comprehension; and c) the members in the MMD group were less able to evaluate their understanding and to implement regulation and correction strategies when confronting comprehension problems. The studies of Meyers and Paris (1981) and Garner and Kraus (1981-82) provided similar results.

Educational Implications

Although the MMD subjects demonstrated some metacognitive knowledge and self-regulation, they still needed intensive training in these areas. Some of the training areas identified in this study are: to learn higher level planning, monitoring and checking strategies, to assess recall readiness, to modify and adjust strategies to task demands, and to assess the

effectiveness of the strategies adopted. When planning instructional programs for MMD students, teachers may consider including these training areas.

Self-regulation and attributional orientation of persons with mental disabilities should be considered in formulating instructional programs. The process of teaching self-regulation should be explored.

Question Related to Attributional Beliefs and Learning Behaviors

Question 5: Are there any differences between MMD subjects and AI subjects in their learning behaviors and attributions of success and failure?

Discussion and Conclusions

Causal attributions of success and failure.

The results of the teachers' observations and subjects' reports with respect to attributional beliefs and learning behaviors were consistent for the AI group but discrepant for the MMD group. Both teachers' and subjects' reports suggested that the AI group attributed its success to effort, ability, and skill, and attributed failure to a lack of effort, ability, and skill. With the MMD group, the teachers perceived that this group attributed its success to chance and luck, and attributed its failure to lack of ability, skill and effort. However, the MMD subjects reported a different view. They indicated that they attributed their success mostly to effort, ability, skill and partly to luck, and their failure to lack of ability, effort, skill and luck. A possible explanation for the discrepancy may be that the MMD subjects tried to provide answers which were socially desirable. However, even though the social desirability factor was accounted for, it appears that MMD subjects were aware that to rely on effort to achieve was more important. Another explanation for the discrepancy may be that the teachers were biased by the students' label. A preoccupation with the label attached to the student may have caused the teachers to stereotype the MMD students and expect them to attribute success to chance and luck, and failure to lack of ability and skill.

Overall, the MMD subjects were not different from AI subjects on the different dimensions of attributions such as effort and ability. No difference was found between AI and MMD subjects' effort attributions for success and failure. The major difference found between them lay within their attributions of luck for a successful outcome. MMD subjects judged luck as a factor in achieving success, and the lack of luck as a factor in determining failure. This finding indicates that the AI subjects were less likely to ascribe lack of luck as a cause of failure.

The results in the area of attributions for the present study varied from the results of other studies. The study of Kurtz and Borkowski (1984) examined the effects of strategy and metacognitive training on memory performance. The results of their study indicated that those subjects who attributed success to controllable factors such as effort, were both more strategic and higher in metamemory knowledge than those who attributed task outcomes to noncontrollable factors such as ability or task characteristics. The results were interpreted as showing that "children with prior dispositions to attribute success to effort and with good metamemory knowledge receive greater cognitive and motivational boosts from strategy training than other children" (Kurtz and Borkowski, 1984, p.352). The findings of Carr, Borkowski and Maxwell's study (1991) were similar to those of Kurtz and Borkowski. The study of Carr et al. (1991) compared academic performance in achieving and underachieving students on the basis of motivational, affective and metacognitive processes. Their findings indicated that the underachievers were less likely to believe that effort was a primary cause of success, whereas achievers tended to believe that effort was related to success. Since the results if this study varied from the results of other studies and there was little apparent attributional difference between the two groups in this study, it is important to conduct further studies to investigate the differences between MMD and AI persons in attributions of success and failure.

Learning behaviors.

When compared with their AI counterparts, the MMD subjects were relatively passive in learning and indicated a lower degree of self-confidence. MMD subjects were less likely to look for alternative solutions to problems, proof-read the assignment without a request to do so, and they worried about examination results. In the area of learning behaviors, the MMD subjects' self-reports were discrepant from those of their teachers'. MMD subjects tended to describe themselves more favourably than did their teachers. The majority of them told the investigator that they would be motivated to learn, do the assignments as soon as possible, and spend an adequate amount of time on completing an assignment. The explanation for such a discrepancy may be that the MMD subjects tried to provide answers which were socially desirable. Even if a social desirability factor was involved in the MMD subjects' reports, however, it is evident that they were aware of the learning behaviors expected from them even though they did not demonstrate these behaviors in this study. The findings from this study may also imply a difference between teacher and student expectations in learning behaviors for MMD students.

Educational Implications

Since MMD subjects in this study tended to judge luck as a factor in achieving success and lack of luck as a factor in determining failure, teachers may consider including attributional retraining in the instructional programs for MMD students. The emphasis may be placed on effort attributions, rather than luck attributions, for success and failure.

Questions Related to the Feasibility of the Assessment Approach

Question 6: Can a multiple assessment approach (teachers' observations, subjects' self-reports and investigator's assessment) yield a global picture of MMD subjects' entry-level memory strategies?

Discussion and Conclusions

This study adopted an investigative approach incorporating the concepts of informal assessment and multiple assessment (teachers' observations, subjects' self-reports, investigator's assessment) to form the first step of dynamic assessment. Dynamic assessment approach involves a "test-teach-test" process with the first step aimed at finding out the initial state of a prescribed target behavior. The approach is informal in the sense that it allows for maximum adaptation of administrative procedures, content, materials, and scoring criteria to meet the needs of a particular assessment situation. Assessment techniques used in this study included a questionnaire to record the observations and predictions of teachers, verbal self-reports to represent the perceptions of the subjects, and an assessment by the investigator using the think-aloud procedures. The approach also involved the use of tasks that students actually encountered in a natural setting and in school. An evaluation of the assessment approach adopted in this study revealed its strengths and weaknesses.

Strengths of the assessment approach.

As indicated in the previous sections, using the present assessment approach provided information and answers to the research questions and offered insight into the nature of memory processes. Information pertaining to the initial state of memory strategies, attributions and learning behaviors was obtained. Multiple assessment also provided teachers with information on areas to explore and strategies to implement.

The adoption of the multiple assessment procedure in this study provides a more global picture of the subjects' memory, attributions and learning behaviors. Multiple assessment also avoids the negative effect of teachers underestimating the MMD subjects, and the MMD subjects reporting socially desirable answers for the research questions. Multiple assessment provided a more reliable measure of results when the data from the three assessments were integrated. The integrated results provide a foundation for

hypothesizing further investigational focuses, as well as initial information for instructional programming of memory strategies and attribution retraining.

A total of not more than two hours was spent with each subject to obtain self-report and assessment data. A considerable amount of information was obtained within a relatively short period of time. The information obtained would be useful for both instructional and research purposes.

Limitations of the assessment approach.

Although efforts had been made to inform the subjects that they were co-investigators in a study, and that their assistance would help the investigator understand how other children learn, responses to some of the assessment tasks were elicited in a testing situation and may have been influenced by the presence of a tape recorder or the novelty of the testing materials employed.

The interview and assessment sessions were conducted by the investigator in a spare classroom within the subjects' school. This arrangement was not naturalistic and may have influenced the responses of the subjects.

It is assumed that verbal explanations provided by the subjects were representative of the thinking processes they had employed. A degree of subjectivity was inevitably involved in the interpretation of responses obtained, even though responses were deemed reliable and interrater reliability was assessed.

In the selection procedure, steps were taken to eliminate subjects with a low language ability or verbal fluency difficulties. However, some MMD subjects or AI subjects with English as a second language may still have been restricted by the verbal mode of expression which was adopted for this study and thus had difficulty verbalizing cognitive processes. This language barrier may have resulted in some masking of strategic strengths.

The technical adequacy of the instruments designed by the investigator, like most informal assessment instruments devised by teachers, is not known and thus does reduce to some extent confidence in the results obtained.

Educational Implications

This study confirmed that an informal multiple assessment approach incorporating observations, self-reports, assessment and think-aloud procedures was feasible to obtain information on the research questions. Classroom teachers should replicate the study in a more naturalistic environment (i.e., tasks administered by classroom teachers in the classroom). Tasks chosen for the assessment should be ecologically relevant and within the ability level and reading level of the students.

When asking MMD students to report their memory processes, investigators should be aware of the limitations of the verbal-report and the think-aloud approach (e.g., the subjects may not report all that they know about memory strategies and strategy monitoring, or they on occasion may report more than they know). Investigators must take precautions to minimize shortcomings of the think-aloud procedure (e.g., using careful probing procedures, including interrater agreement, and collecting converging data), and maximize its advantages (e.g., obtaining a rich and more comprehensive data pool, providing a greater insight into the subjects' strategic behaviours and analysis of motivational components of strategy monitoring). If utilized properly, the think-aloud procedure and multiple assessment approach yield important data about the memory strategies of MMD students. As suggested by Meyer et al. (1990), to facilitate a proper representation of memory processes through verbal reports, training in the think-aloud procedure is highly essential. In this study, the subjects were provided with practice in the think-aloud procedure prior to performing the tasks in Instruments 2, and 3. After the practice, it was observed that the subjects were generally comfortable with the procedure and enjoyed the process of thinking out loud their strategies. In addition, appropriate prompts and prompting in a non-cueing fashion by the investigator also assisted the subjects in accessing their memory processes.

When analyzing the data, verbal responses were usually reduced to certain metacognitive themes for quantitative analysis. Since this data reduction

process is highly subjective, controversy over data analysis may exist. To reduce the problem of subjectivity and to assess the reliability of data collected, an interrater agreement should be calculated and accessed.

The results of this study support the use of a multiple assessment approach to determine the initial state of strategy usage before any intervention occurs. The accessibility of specific strategies or the knowledge at the initial stage of training assists in the formulation of what to teach and how to teach it. In other words, the multiple assessment approach adopted in this study forms the first step of dynamic assessment. The second step is to teach the strategies, and the third step is to test again to ascertain whether the students have successfully learned the strategies. For example, the results of this study indicated that the MMD students needed to learn more complex strategies (e.g., elaborative rehearsal and mnemonics), regulate the strategies more effectively, attribute their success to effort rather than luck, and when necessary, to use a deep learning approach rather than a surface approach. Teachers can accordingly formulate what to teach and the approach to teach it. After implementing the intervention program, teachers can test the students again to evaluate the effectiveness of the intervention program, and determine what subsequent program revisions are required.

Limitations of the Study

It is noted that the following factors may have limited the interpretations and generalizations of the findings:

1. **Limitation in selection criteria** -- The selection criteria for the subjects utilized in this study has a weakness. One hour was required to administer each of the instruments and to interview each student. Consequently, it was not practical to administer an intelligence test or standardized achievement test to all the participants in the study. It was necessary, therefore, to rely initially upon the accuracy and validity of the test results available from the school concerned, and finally upon the verification of

the subjects' current academic performance and emotional status by the teachers and other school personnel.

2. Limitations in generalization --

(A) The relatively small sample size in this study may have affected generalization.

(B) The sample of AI subjects was homogeneous in that all of them came from lower social economical status and the majority of them had a home language which was not English. The findings of this investigation will be applicable to students having similar characteristics. It may not be possible to generalize the results to all students with average intelligence.

(C) The study involved students from one school in the inner city of Edmonton. It is unclear to what extent the findings of the memory strategy assessment may be generalized on a wider basis.

(D) The MMD subjects were from an integrated setting and the results may not be generalized to a segregated setting.

(E) The gender of the subjects in the two groups was not matched and there were more female subjects than male subjects in this study. The results of this study may not be generalized to situations where there are different proportions of male and female subjects.

Due to the above-mentioned limitations, generalization of the present findings is limited to students with similar background to the subjects in this study. For students who are more or less mature users of memory strategies or who are from different cultural backgrounds, the findings on initial memory strategies could be quite different. Replication of this study at another level with another group of subjects is required before the results can be justifiably applied to students with other backgrounds.

Research Implications

The results of this study have served to further our knowledge base and understanding of memory strategies, attributions and learning behaviours of students with mild mental disabilities. Factors which are important in differentiating students with mental disabilities and students with average intelligence have been delineated. The findings do not in any way, however, provide us with a comprehensive understanding of this complex issue, and it therefore follows that further investigations are required. The following suggestions could help in further studies of memory strategy assessment.

1. It would be desirable to use a more natural environment and involve the teachers in an investigative role. The teachers will predict, interview and assess the students in a natural setting (e.g., classroom), with curriculum relevant assessment tasks.

2. When replicating this study, it would be necessary to introduce changes in the test battery: involving tasks relevant to the new subjects' curriculum or environment. The investigator should check with individual schools to ensure that the tasks are relevant to those that the students encounter in that particular school.

3. To generalize the findings to other populations, it would be necessary to adopt some changes, such as administering the test battery to a larger population, administering the battery to subjects with different/same cultural background, administering the battery to subjects with English as a first language, and to ascertain whether the results of this study can be generalized to other conditions, or to a global environment.

4. When replicating this study, it would be desirable to include an attempt to document linguistic problems which are perceived as contributors to the difficulties of the MMD subjects in think-aloud procedures.

5. The variable of the individual differences in attention focusing and attention switching which have not been systematically investigated should be

included in a further investigation. This knowledge will contribute to the understanding about the nature of attention with relation to metacognition.

6. The variable of cultural and familial influence on attributional beliefs should also be included in further studies. Borkowski (1992) suggested that the children's attitudinal beliefs about the causes of learning and the malleability of their minds are formed in the home and then strengthened in the school environment. There are also cultural and familial transmission of attributional beliefs for success and failure in academic settings. Since the subjects in this study have diverse cultural backgrounds, it might be necessary to investigate how the cultural backgrounds of students have influenced their attributional beliefs. In addition, future research needs to focus on the developmental roots of dysfunctional attributional patterns that influence persons with mental disabilities.

7. A study may be conducted to investigate the extent to which learning behaviors (e.g., mental effort, motivation, and level of processing) are associated with the use of simple or complex strategies.

8. A study may be considered to investigate whether the MMD students' limited range of memory strategies and cognitive inflexibility were closely related to the lack of sensitivity towards the nature of the tasks when using strategies.

9. Since mnemonics were not taught to the subjects in this study, they did not use this strategy other than for one occurrence of first-letter mnemonics. It would be interesting to examine the group differences in the use of mnemonics after the strategy had been taught to both groups.

10. Attributions of success and failure were the only motivational variable included in this study. Other motivational variables such as self-esteem, task persistency and expectancy of success may also be relevant to memory strategy monitoring and performance. Exploration of these other motivational variables seems necessary.

11. Further research may be needed to examine the relationship between motivational factors (e.g., attributional beliefs, patterns of motives), student learning approaches (e.g., surface, deep and achievement approaches), memory strategy monitoring and transfer of strategy of mildly mentally disabled persons.

References

Afflerback,P., & Johnson,P. (1984). Research methodology on the use of verbal reports in reading research. Journal of Reading Behavior, 16, 107-322.

Alexander, P.A., Hare, V.C., & Garner, R. (1984). The effect of time, access, and question type on response accuracy and frequency of lookbacks in older, proficient readers. Journal of Reading Behavior, 16, 119-130.

Andre, T., & Phye, G.D. (1986). Cognition, learning, and education. In G.D. Phye, & T. Andre (Eds.). Cognitive classroom learning, understanding, thinking and problem solving. Orlando, Florida: Academic Press Inc.

Ashcraft, M.H. (1989). Human memory and cognition. Boston: Scott, Foreman and Company.

Ashman, A.J. (1984). The cognitive abilities of the moderately and severely retarded. In J.R. Kirby (Ed.), Cognitive strategies and educational performance (pp.249-278), New York: Academic Press, Inc.

Bachor, D.G. (1991). Thinking skills or strategic behavior and arithmetic word problems: Research, assessment, and instruction. In R. F. Mulcahy, R. H. Short, & J. Andrews (Eds.), Enhancing learning and Thinking (pp.137-159). New York: Praeger Publisher.

Bachor, D.G., & Crealock, C. (1986). Instructional strategies for students with special needs. Scarborough, Ont.: Prentice-Hall.

Baine, D., (1986). Memory and instruction. New Jersey: Educational Technology Publications.

Baumeister, A.A. (1967). Problems in comparative studies of mental retardates and normals. American Journal of Mental Deficiency, 71, 869-875.

Bennett, R.E. (1982). Cautions for the use of informal measures in the educational assessment of exceptional children. Journal of Learning Disabilities, 15, 337-339.

Bereiter, C., & Bird, M. (1985). Use of thinking aloud in identification and teaching of reading comprehension strategies. Cognition and Instruction, 2, 131-156.

Biggs, J.B. (1987). Student approaches to learning and studying. Hawthorn, Vic: Australian Council for Eudcational Research.

Borkowski, J.G. (1992). Metacognitive theory: A framework for teaching literacy, writing and math skills. Journal of Learning Disabilities, 25, 253-257.

Borkowski, J.G., & Cavanaugh, J.C. (1979). Maintenance and generalization of skills and strategies by the retarded. In N.R. Ellis (Ed.), Handbook of mental deficiency : Psychological theory and research (pp.569-671). Hillsdale, NJ: Lawrence Erlbaum Associates.

Borkowski, J.G., Carr, M., & Pressley, M. (1987). Spontaneous strategy use: Perspective from metacognitive theory. Intelligence, 11, 61-75.

Borkowski, J.G., Carr, M., Rellinger, L., & Pressley, M. (1990). Self regulated cognition: Interdependence of metacognition, attributions and self-esteem. In B. Jones & L. Idol (Eds.), Dimensions of thinking and cognitive instruction (Vol.1, pp. 53-92). Hillsdale, NJ: Erlbaum.

Borkowski, J.G., Day, J.D., Saenz, D.D., Estrada, T. M., Groteluschen, A. (1992). Expanding the boundaries of cognitive interventions. In B.Y.L. Wong (Ed.), Contemporary intervention and research in learning disabilities: An international perspective (pp.1-21). New York: Springer-Verlag.

Borkowski, J.G., Johnston, M.B., & Reid M.K. (1986). Metacognition, motivation, and controlled performance. In S. J. Ceci (Ed.), Handbook of social and neuropsychological aspects of learning disabilities (pp.147-173), Vol.2, Hillsdale, New Jersey: Lawrence Erlbaum Associates.

Borkowski, J.G., Milstead, M., & Hale, C. (1988). Components of children's metamemory: Implications for strategy generalization. In F. Weinert & M. Perlmutter (Eds.), Memory development: Individual differences and universal changes (pp.73 -100). Hillsdale, NJ: Erlbaum.

Borkowski, J.G., Weyhing, R.S., & Carr, M. (1988). Effects of attributional retraining on strategy-based reading comprehension in learning disabled students. Journal of Educational Psychology, 80, 46-53.

Bray, N.W., & Turner, L.A. (1986). The rehearsal deficit hypothesis. In N.R. Ellis & N.E. Bray (Eds.), International Review of Research in Mental Retardation, Vol.14, Orlando, Florida: Academic Press.

Brown, A.L. (1975). The development of memory: Knowing, knowing about knowing, and knowing how to know. In H.W. Reese (Ed.), Advances in child development and behavior, Vol.10, New York: Academic Press.

Brown, A.L. (1978). Knowing when, where & how to remember: A problem of metacognition. In R. Glaser (Ed.), Advances in instructional psychology (pp.77-165). Hillsdale, NJ: Lawrence Erlbaum Associates.

Brown, A.L. (1980). Metacognitive development and reading. In R.J. Spiro, B.C. Bruce and W.F. Brewer (Eds.), Theoretical issues in reading comprehension: Perspectives from cognitive psychology, linguistics, artificial intelligence and education (pp. 453-481). Hillsdale, NJ: Lawrence Erlbaum Associates.

Brown, A.L. (1981). Metacognition: The development of selective attention strategies for learning from texts. In M.L. Kamil (Ed.). Directions in reading: Research and instruction. Washington D.C.: The National Reading Connference, Inc.

Brown, A.L. (1982). Learning and development: The problems of compatibility, access and induction. Human Development, 25, 89-115.

Brown, A. L. (1987). Metacognition, executive control, self-regulation, and other more mysterious mechanisms. In F.E. Weinert & R.H. Klewe (Eds.), Metacognition, motivation and understanding (pp.65-116). Hillsdale, NJ: Erlbaum.

Brown, A.L., Armbruster, B.B., & Baker, L. (1986). The role of metacognition in reading and studying. In J. Orasanu (Ed.), Reading comprehension: From research to practice (pp.49-75). Hillsdale, NJ: Erlbaum.

Brown, A.L., & Barclay, C.R. (1976). The effect of training specific mnemonics on the metamnemonic efficiency of retarded children. Child Development, 47, 71-80.

Brown, A.L., Bransford, J.D., Ferrara, R.A., & Campione, J.C. (1983). Learning, remembering and understanding. In J.H. Flavell & E.M. Markham (Eds.), Carmichael's manual of child psychology, 4th Ed., Vol.3, (pp.77-166). New york: Wiley.

Brown, A.L., & Campione, J.C. (1977a). Memory strategies in learning: Training children to study strategically. In H. Pick, H. Leibowitz, J. Singer, A. Steinschneider, & H. Stevenson (Eds.), Application of basic research in psychology New York: Plenum.

Brown, A.L., & DeLoache, J.S. (1978). Skills, plans, and self-regulation. In R. Siegler (Ed.), Children's thinking: what develops, (pp.3-36). Hillsdale, NJ: Erlbaum.

Brown, A.L., & Palincsar, A.S. (1987). Reciprocal teaching of comprehension strategies: A natural history of one program for enhancing learning. In J.J. Day & J. Borkowski (Eds.), Intelligence and exceptionality, (pp. 81-132). Norwood, NJ: Ablex.

Campione, J.C., & Brown, A.L. (1977). Memory and metamemory development in educable mentally retarded children. In R.J. Sternberg (Ed.), Handbook of human intelligence (pp.382-490). Cambridge, England: Cambridge University Press.

Carr, M., & Borkowski, J.G. (1989). Attributional retraining and the generalization of reading strategies by underachievers. Human Learning and Individual Differences, 1, 327-341.

Carr, M., Borkowski, J.J., & Maxwell, S.E. (1991). Motivational components of underachievement. Developmental Psychology, 27, 1, 108-118.

Cavanaugh, J.C., & Borkowski, J.J. (1980). Searching for metamemory -- memory connections: A developmental study. Developmental Psychology, 16, 441-453.

Cavanaugh, J.C., & Perlmutter, M. (1982). Metamemory: A critical examination. Child Development, 53, 11-18.

Chi, M.T.H. (1978). Knowledge structures and memory development. In R.Siegler (Ed.), Children's thinking: What develops? (pp.73-79). Hillsdale, NJ: Erlbaum.

Chi, M.T.H. (1987). Representing knowledge and metaknowledge: Implications for interpreting metamemory research. In F.E. Weinert & R.H. Kluwe (Eds.), Metacognition, motivation and understanding (pp.239-266). Hillsdale, NJ: Erlbaum.

Cook, L.K., & Meyer, R.E. (1983). Reading strategy training for meaningful learning from prose. In M. Pressley & J. Levin (Eds.). Cognitive strategy training. New York: Springer-Verlag.

Craik, F.I.M., & Lockhart, R.S. (1972). Levels of processing: A framework for memory research. Journal of Verbal Learning Verbal Behavior, 11, 671-684.

Craik, F.I.M., & Watkins, M.J. (1973). The role of rehearsal in short-term memory. Journal of Verbal Learning and Verbal Behavior, 8, 524-528.

Day, J.D., & Hall, L.K. (1987). Cognitive assessment, intelligence, and instruction. In J.D. Day & J.G. Borkowski (Eds.), Intelligence and exceptionality : New directions for theory, assessment, and instructional practices (pp.57-80). Norwood, N.J.: Ablex Publishing Corporation.

Derry, S.J., & Murphy, D.A. (1986). Designing systems that train learning ability: From theory to practice. Review of Educational Research, 56, 1-39.

Deshler, D.D., & Alley, G.R. (1979). Instructional practices that promote acquisition of generalization and skills by learning disabled adolescents. Kansas: University of Kansas.

Detterman, D.K. (1979). Memory in the mentally retarded. In N.R. Ellis (Ed.), Handbook of mental deficiency: Psychological theory and research (pp.727-760). 2nd ed., Hillsdale, NJ: Lawrence Erlbaum Associates.

Ellis, W.K. (1969). A behavioral strategy in mental retardation: Defence and critique. American Journal of Mental Deficiency, 73, 557-566.

Ellis, N.R. (1970). Memory processes in retardates and normals. In N.R. Ellis (Ed.), International review of research in mental retardation (Vol.4, pp.1-32). New York: Academic Press.

Ellis, N.R., Katz, E. & Williams, J.E. (1987). Developmental aspects of memory for spatial location. Journal of Experimental Child Psychology, 44, 401-412.

Ellis, N.R., Palmer, R.L., & Reeves, C.L. (1988). Developmental and intellectual differences in frequency processing. Developmental Psychology, 24, 38-45.

Ericsson, K.A., & Simon, H.A. (1980). Verbal reports as data. Psychological Review, 87, 215-251.

Estes, W.K. (1970). Learning theory and mental development. New York: Academic Press.

Eyde, D.R., & Altman, R. (1978). An exploration of metamemory processes in mildly and moderately retarded children: Final report. University of Missouri, Columbia, Mo: Department of Special Education, Columbia.

Feurstein, R. (1980). Instrumental enrichment: An intervention program for cognitive modifiability. Baltimore, MD: University Park Press.

Fischer, R.P., & Mandl, H. (1982). Metacognitive regulation of text processing: Aspects and problems concerning the relation between self-statements and actual performance. In A. Flammer & W. Kintsch (Eds.), Discourse processing (pp. 339-351). Amsterdam: North Holland.

Flavell, J.H. (1970). Developmental studies of mediated memory. In H.W. Reese & L.P. Lipsitt (Eds.), Advances in child development and behavior, Vol.5. New York: Academic Press.

Flavell, J.H. (1981). Cognitive monitoring. In P. Dickson (Ed.), Children's oral communication skills (pp.35-60). New York: Academic Press.

Flavell, J.H., & Wellman, H.M. (1977). Metamemory. In R.V. Kail, Jr. & J.W. Hagen (Eds.), Perspectives on the development of memory and cognition (pp.3-34). Hillsdale, NJ: Erlbaum.

Forrest-Pressley, D.L, & Waller, T. (1984). Cognition, metacognition, and reading. New York: Springer.

Forrest, D.L., & Waller, T.G. (1980). What do children know about their reading and study skills? Paper presented at the annual meeting of the American Educational Research Association, Boston.

Frederiken, N. (1984). The real test bias: Influences of testing on teaching and learning. American Psychologist, 39, 193-202.

Frederiken, J.R., & Collin, A. (1989). A system approach to educational testing. Educational Researcher, 18, 27-32.

French, F. F. (1985). Cognitive strategy assessment and intervention with educable mentally handicapped adolescents. Unpublished doctoral dissertation, University of Alberta.

Friedman, M., Krupski, A., Dawson, E.T. & Rosenberg, P. (1977). Metamemory and mental retardation: Implications for research and practice. In P. Mittler (Ed.), Research to practice in mental retardation, Vol.2, Baltimore: University Park Press.

Gagne, R.M. (1977). The conditions of learning, (3rd ed.). New York: Holt, Rinehart and Winston.

Garner, R. (1987). Metacognition and reading comprehension. Norwood, NJ: Ablex.

Garner, R. (1988). Verbal-report data on cognitive and metacognitive strategies. In C. E. Weinstein, E.T. Goetz, & P. A. Alexander (EDs.), Learning and study strategies: Issues in assessment, instruction, and evaluation (pp. 63-76). San Diego, CA: Academic Press.

Garner, R., & Kraus, C. (1981-1982). Good and poor comprehender differences in knowing and regulating reading behaviors. Educational Research Quarterly, 6, 5-12.

Hagen, J.W., & Stanovich, K.E. (1977). Memory strategies of acquisition. In R.V. Kail, Jr. & J.W. Hagen (Eds), Perspectives on the development of memory and cognition (pp.89-112). Hillsdale, NJ: Erlbaum.

Hallahan, D., & Kauffman, J.M. (1982). Exceptional children (2nd ed.). Englewood Cliffs, Prentice-Hall.

Haywood, H.C., & Wingenfeld, S.A. (1992). Interactive assessment as a research tool. The Journal of Special Education, 26, 263-268.

Hiebert, J., & Wearne, D. (1986). Procedures over concepts: The acquisition of decimal number knowledge. In J. Hiebert (Ed.), Conceptual and procedural knowledge: The case of mathematics. Hillsdale, N. J.: Erlbaum.

Jacobsen, B., Lowery, P., & DuCette, J. (1986). Attributions of learning disabled children. Journal of Educational Psychology, 78, 59-64.

Justice, E.M. (1985). Metamemory: An aspect of metacognition in the mentally retarded. In Ellis, N.R. (ed.), International Review of Research in Mental Retardation, Vol.13, (pp.79-108). Orlando, Florida : Academic Press.

Kail, R., & Bisanz, J. (1982). Information processing and cognitive development. In H. W. Reese (Ed.), Advances in child development and behavior, Vol.17. New York: Academic Press.

Kellogg, R.T. (1982). When can we introspect accurately about mental processes? Memory and Cognition, 10, 141-144.

Kendall, C.R., Borkowski, J.G., & Cavanaugh, J.C. (1980). Metamemory and the transfer of an interrogative strategy by EMR children. Intelligence, 4, 255-270.

Kendall, P.C. (1990). Challenge for cognitive strategy training: the case of mental retardation. American Journal on Mental Retardation, 90, 364-367.

Kintsch, W., & Greeno, J. G. (1985). Understanding and solving word arithmetic problems. Psychological Review, 92, 109-129.

Kirby, J.R. (1984). Cognitive strategies and educational performance. New York: Academic Press, Inc.

Kramer, J.J., & Engle, R.W. (1981). Teaching awareness of strategic behavior in combination with strategy training: Effects on children memory performance. Journal of Experimental Child Psychology, 32, 513-530.

Kreutzer, M.A., Leonard, C., & Flavell, J.H. (1975). An interview study of children's knowledge about memory. Monographs of the Society for Research in Child Development, 40, (1, Serial No.159), 1-58.

Kulhavy, R.W. & Schwartz, N.H. (1986). Working memory: The encoding process. In G.D. Phye & T. Andre (Eds.), Cognitive classroom learning: Understanding, thinking and problem solving (pp.115-140). Orlando, Florida: Academic Press Inc.

Kurtz, B.E., & Borkowski, J.G. (1984). Children's metacognition: Exploring relations among knowledge, process, and motivational variables. Journal of Experimental Child Psychology, 37, 335-354.

Leinhardt, G. (1982). Overlap: Testing whether it is taught. In G.F. Nadaus (Ed.), The courts, validity, and minimum competency testing (pp.151-168). Boston: Kluwer- Nijhoff Publishing.

Lupart, M.E. (1984). Strategic intervention and reading comprehension monitoring. Unpublished doctorial dissertation, University of Alberta.

Marsh, H.W., Cairns, L., Relich, J., Barnes, J., & Debus, R.L. (1984). The relationship between dimensions of self-attribution and dimensions of self-concept. Journal of Educational Psychology, 76, 3-32.

Meacham, J.A. (1962). The development of memory abilities in the individual and in society. Human Development, 15, 205-228.

Meichenbaum, D. (1980). Cognitive behavior modification with exceptional children: A promise yet unfulfilled. Exceptional Education Quarterly, 1, 83-88.

Meyer, B. J. F., Brandt, D. M., & Blutch, G.J. (1980). Use of top-level structure in text: Key for reading comprehension of ninth-grade students. Reading Research Quarterly, 16, 72-103.

Meyers, J. (1988). Diagnosis diagnosed: Twenty years after. Professional School Psychology, 3, 123-134.

Meyers, J., & Lytle, S. (1986). Assessment of the learning process. Exceptional Children, 53, 138-144.

Meyers, J., Lytle S., Palladino, D., Devenpect, G., & Green, M. (1990). Think aloud protocol analysis: An investigation of reading comprehension strategies in fourth- and fifth-grade students. Journal of Psychoeducational Assessment, 8, 112-127.

Meyer, J., & Paris, S.G. (1981). Children's metacognitive knowledge about reading. Journal of Educational Psychology, 70, 680-690.

Meyers, J., Pfeffer, J., & Erbaum, V. (1985). Process assessment: A model for broadening assessment. Journal of Special Education, 19, 73-89.

Mirkin, P.K., Fuchs, L.S., & Deno, S.L. (Eds.) (1982). Considerations for designing a continuous evaluation system: An integrative review (Monograph #20). Minneapolis: University of Minnesota. Institute for Research on Learning Disabilities.

Moynahan, E.D. (1973). The development of knowledge concerning the effect of categorization upon free recall. Child Development, 44, 238-246.

Mulcahy, R. F. (1980). Memory: Some selective aspects. In R. Jarmin (Ed.), Issues in developmental disabilities.

Mulcahy, R.F. (1991). Developing autonomous learner. Alberta Journal of Educational Research, 37, 385-397.

Mulcahy, R.F., & Marfo, K. (1987). Assessment of cognitive ability and instructional programming with native Canadian children: a cognitive processes perspective. In L.L. Stewin and J.H. McCann (Eds.), Contemporary educational issues -- the Canadian mosaic (pp.157-177). Toronto, Ont: Copp Clark Pitman.

Mulcahy, R., Marfo, K., Peat, D., Andrews, J., & Clifford, L. (1986). Applying cognitive psychology in the classroom: A learning/thinking strategies instructional program. Alberta Psychology, 15, 3, 9-12.

Mulcahy, R.H., Marfo, K., Peat, D.W. and Andrews, J. (1987). SPELT: A strategies program for effective learning/thinking -inservice edition. Available from the Cognitive Education Project, Department of Education Psychology, Unieversity of Alberta.

Naus, M.J., & Ornstein, P.A. (1983). Development of memory strategies: Analysis, questions, and issues. In M.Y.H. Chi (Ed.), Trends in memory development research (pp. 1-30). New York: Karger.

Neisser, U. (1967). Cognitive psychology. New York: Appleton-Century Crofts.

Newman, D., Griffin, P., & Cole, M. (1989). The construction zone: Working for cognitive change in school. New York : Cambridge University Press.

Nicholls, J.G. (1989). Competence and accomplishment: A psychology of achievement motivation. Cambridge, MA: Harvard University Press.

Nickerson, R.S. (1989). New directions in Educational Assessment. Educational Researcher, 18(9), 3-6.

Nisbett, R.E., & Wilson, T.D. (1977). Tell more than we can know: Verbal reports on mental processes. Psychological Review, 84, 231-259.

Norris, S.P. (1989). Can we test validly for critical thinking? Educational Researcher, 18, 21-26.

Paris, S.G., Lipson, M.Y., & Wixson, K.K. (1983). Becoming a strategic reader. Comtemporary Educational Psychology, 8, 293-316.

Pauker, R.A., (1987). Teaching thinking and reasoning skills -- Problems and solutions. American Association of School Administrators.

Peterson, P.L., Swing, S.R., Braverman, M.T., & Buss, R. (1982). Students' aptitudes and their reports of cognitive processes during direct instruction. Journal of Educational Psychology, 74, 535-547.

Phifer, S.J., & Glover, J.A. (1982). Don't take students' word for what they do while reading. Bulletin of Psychonomic Society, 19, 194-196.

Pressley, M. (1990). Four more considerations about self-regulation among mentally retarded persons. American Journal of Mental Retardation, 94, 369-371.

Pressley, M., Borkowski, J.G., & Schneider, W. (1987). Cognitive strategies: Good strategy users coordinate metacognition and knowledge. In R. Vasta & G. Whitehurst (Eds), Annals of Child Development (Vol.5, pp.89-129). New York: JAI-Press.

Pressley, M., Borkowski, J.G., & O'Sullivan, J.T. (1985). Memory strategies are made of this: Metamemory and strategy instruction. Educational Psychologist, 19, 94-107.

Reid, M.K., & Borkowski, J.G. (1987). Casual attributions of hyperactive children: Implications for teaching strategies and self-control. Journal of Educational Psychology, 79, 296-307.

Robinson, N. M., & Robinson, H.B. (1976). The mentally retarded child. New York: Mcgraw-hill.

Salvia, J., & Ysseldyke, J.E. (1981). Assessment in special and remedial education (2nd ed.). Boston: Houghton-Mifflin.

Sattler, J. (1988). Assessment of children (3rd ed.). San Diego: Author.

Scardamalia, M. & Beriter, C. (1983). Child as coinvestigator: Helping children gain insight into their own mental processes. In S.G. Paris, G.M. Olson, & H.W. Stevenson (Eds.), Learning and motivation in the classroom (pp. 61-82). Hillsdale, NJ: Erlbaum.

Schneider, W. (1985). Developmental trends in the metamemory-memory behavior relationship: An integrative review. In D.L. Forrest-Pressley, G.E. MacKinnon, & T.G. Waller (Eds.), Metacognition, cognition, and human performance. New York: Academic Press.

Schneider, W., & Pressley, M. (1989). Memory development between 2 and 20. New York: Springer-Verlag

Schulte, A.C., & Weinstein, C.E. (1981). Inventories to assess cognitive learning strategies. Paper presented at the annual meetings of the American Educational Research Association, Los Angeles, CA.

Scruggs, T.E. & Mastropieri, M.A. (1989). Mnemonic instruction of learning disabled students: A field- based evaluation. Learning Disability Quarterly, 12, 119-125.

Scruggs, T.E. & Mastropieri, M.A. (1990). The case for mnemonic instruction: From laboratory research to classroom application. The Journal of Special Education, 24, 1, 6-32.

Sears, N.C., & Johnson, D.M. (1986). The effects of visual imagery on spelling performance and retention among elementary students. Journal of Educational Research, 79, 4, 230-223.

Short, E.J., Evans, S.W., Friebert, S.E., Schatschneider, C.W. (1991). Thinking aloud during problem solving: Facilitating effects. Learning and Individual Differences, 3, 109-122.

Siegler, R.S. (1989). Strategy diversity and cognitive assessment. Educational Researcher, 18(9), 15-20.

Simon, H.A. (1979). What the knower knows: Alternative strategies for problem-solving tasks. In F. Klix (Ed.), Human and artificial intelligence. Armsterdam: North Holand.

Snart, F., O'Grady, M., & Das, J.P. (1982). Cognitive processing in subgroups of moderately retarded children. American Journal of Mental Deficiency, 86, 465-472.

Snow, R.E., (1989). Toward assessment of cognitive and conative Structures in learning. Educational Researcher, 18, 8-14.

Snowman, J. (1986). Learning tactics and strategies. In G.D. Phye & T. Andre (Eds.), Cognitive classroom learning: Understand, thinking, and problem solving (pp.243-275). New York: Academic Press.

Sternberg, R.J. (1984). What should intelligence tests test? Implication of a triarchic theory of intelligence for intelligence testing. Educational Research, 13, 5-15.

Sternberg, R.J., & Powell, J.S. (1983). The development of intelligence. In P.H. Mussen (Ed.), Handbook of child psychology (4th edition) (Vol. 3, pp. 341-419). New York: Wiley.

Sternberg, R.J. (1986). Intelligence applied. Toronto: Harcourt Brace Jovanovich.

Sternberg, R. J., & Martin, M. (1988). When teaching thinking does not work, what goes wrong? Teachers College Record, 89, 555-578.

Stiggins, R.J. (1988). The case for classroom assessment of thinking skills. Teaching Thinking and Problem Solving, 10(4), 7-10.

Swanson, H.L. (1983). Relations among metamemory, rehearsal activity and word recall of learning disabled and non-disabled readers. British Journal of Educational Psychology, 53, 186-194.

Swanson, H.L. (1986). Do semantic memory deficiencies underlie disabled readers' encoding processes? Journal of Experimental Child Psychology, 41, 461-488.

Swanson, H.L. (1987). Information processing theory and learning disabilities: A commentary and future perspective. Journal of Learning Disabilities, 20, 3, 155-165.

Tawney, J.W., & Gast, D.L. (1984). Single subject research in special education. Columbus, Ohio: Bell & Howell Company.

Taylor, A.M., Josberger, M., & Whitely, S.E. (1973). Elaboration instruction and verbalization as factors facilitating retarded children's recall. Journal of Educational Psychology, 64, 341-346.

Thurlow, M.L., & Ysseldyke,J.E. (1982). Instructional planning: Information collected by school psychologists vs. information considered useful by teachers. Journal of School Psychology, 20, 3-11.

Torgesen, J., & Kail, R. (1982). Memory processes in exceptional children. In Keogh, B. (Ed.), Advances in special education. Greenwich, Connecticut: JAI Press.

Turner, L.A., & Bray, N.W. (1985). Spontaneous rehearsal in mildly mentally retarded children and adolescents. American Journal of Mental Deficiency, 90, 57-63.

Wechsler, D. (1974). Manual for the Wechsler Intelligence scale for Children - Revised. San Antonio: The Psychological Corporation.

Weinstein, C.E., & Underwood, V.L. (1985). Learning strategies: The how of learning. In J. Segal, S. Chipman, & R. Glaser (Eds.), Relating instruction to basic research. Hillsdale, NJ: Erlbaum.

Weinstein, C.E., Goetz, E.T. & Alexander, P.A. (1988). Learning and study strategies. San Dieago, California: Academic Press, Inc.

Weisz, J.R. (1976). Studying cognitive development in retarded and nonretarded groups: The role of theory. American Journal of Mental Deficiency, 81, 235-239.

Weisz, J.R. (1977). Follow-up developmental study of hypothesis behavior among mentally retarded and non-retarded children. Journal of Experimental Child Psychology, 24, 108-122.

White, P. (1980). Limitations on verbal reports of internal events: A refutation of Nisbett and Wilson and of Ruddel. Psychological Review, 87, 105-112.

Whitman, T.L. (1990). Self-regulation and mental retardation. American Journal on Mental Retardation, 94, 4, 347-362.

Wong, B.Y.L. (1985). Metacognition and learning disabilities. In T.G. Waller, D. Forrest-Pressley & E. MacKinnon (Eds.), Metacognition, cognition and human performance (pp.137-180). New York: Academic Press.

Wong, B.Y.L. (1986). Metacognition and special education: A review of a view. The Journal of Special Education, 20, 1, 9-29.

Ysseldyke, J.E. (1979). Issues in psychoeducational assessment. In G.D. Phye & D.J. Reschly (Eds.), School psychology: Perspectives and issues (pp.87-122). New York: Academic Press.

Yussen, S.R., & Bird, J.E. (1979). The development of metacognitive awareness in memory, communication, and attention. Journal of Experimental Child Psychology, 28, 300-313.

Yussen, S.R., Mathews, S.R. & Hiebert, E. (1982). Metacognitive aspects of reading. In W. Otto, & S. White (Eds.), Reading expository material (pp. 189-218). New York: Academic Press.

Zeaman, D., & House, B.J. (1963). The role of attention in retardate discrimination learning. In N.R. Ellis (Ed.), Handbook of mental deficiency (pp.63-120). New York: McGraw-Hill.

Zigmond, N., & Silverman, R. (1984). Informal assessment for program planning and evaluation is special education. Educational Psychologist, 19, 3, 163-171.

Zimmerman, B.J., & Schunk, D.H. (1989). Self-regulated learning and academic achievement. New York: Springer-Verlag.

APPENDIX A

SUBJECT BACKGROUND INFORMATION FORM

NAME:
DATE OF BIRTH:
PLACE OF BIRTH:
SCHOOL:
GRADE:
HAS ENROLLED IN THE PRESENT SCHOOL SINCE:
RETENTION/REPETITION: NO/ YES (GRADE ___)
TYPE OF SPECIAL CLASS/PROGRAM: _____
_____

SUBJECTS CURRENTLY TAKING/MARKS:

___ _____
___ _____
___ _____
___ _____
___ _____
___ _____
___ _____
___ _____
___ _____
___ _____

SOCIAL HISTORY: _____
_____
_____

OUTSTANDING DEFICITS:
PHYSICAL: NO/YES _____
SENSORY : NO/YES _____
BEHAVIORAL:NO/YES _____
ATTENTION :NO/YES _____
LANGUAGE/CULTURAL: NO/YES _____

LANGUAGE SPOKEN AT HOME: _____

ASSESSMENT RESULTS:

1. WISC-R
   DATE ADMINISTERED:
   VIQ:
   PIQ:
   FIQ:
   REMARKS:_____
_____
_____
_____

2. CCAT
   DATE ADMINISTERED:
   RESULTS:_____
_____
_____
_____
   REMARKS:_____
_____
_____

3. OTHER PREVIOUS ASSESSMENT RESULTS (e.g., INTELLIGENCE, ACHIEVEMENT, VISION, HEARING)

ASSESSMENT (DATE)	RESULTS

APPENDIX B

INSTRUMENT NO. 1
TEACHER QUESTIONNAIRE ON MEMORY STRATEGIES

NAME OF TEACHER:
NAME OF STUDENT:
SCHOOL:
CURRENT GRADE:
DATE:

Note:

1. The purpose of this questionnaire is to find out some information about the factors that help students learn. Three factors that influence learning: learning behaviors, attributions, and memory strategies are being investigated by this questionnaire.

2. Please complete a separate questionnaire for each student included in the study.

3. Please read the questionnaire and observe the student before completion.

4. Please give information on what the student usually does, not what you would like him/her to do.

5. If you would like to elaborate on your answers or add your opinions, please write in the space provided or attach a separate sheet of paper.

6. Your contribution, by filling out this questionnaire, will be valuable in helping to improve how students learn and remember information.

QUESTIONNAIRE

PART ONE: STUDENT'S USE OF STRATEGIES

1. This questionnaire investigates students' use of four types of memory strategies: maintenance rehearsal, elaborative rehearsal, visual imagery and mnemonic strategies.

a) Maintenance rehearsal (MR) involves the rote repetition of to-be-remembered information. Examples of maintenance rehearsal are: rote repetition of a list of words; mentally going through the action of hitting a ball.

b) Elaborative rehearsal (ER) involves strategies for categorizing, grouping and chunking, or using meaningful relationships among to-be-remembered items in order to facilitate memory. Examples of elaborative rehearsal are: these words begin with the letter "J"; these are the things I like.

c) Visual imagery (VI) involves forming mental pictures of to-be-remembered material to facilitate better memory. For example, to remember a word pair "dog-cigar", a child may form a mental picture of "a dog smoking a cigar".

d) Mnemonic strategies (MS) involve embellishing the incoming material by creatively interrelating the items-to-be-learned or by associating the items to a previously learned set of peg words or images. Examples of mnemonic strategies include the Peg Method (e.g., one is a bun, two is a shoe...), Loci Method (e.g., associating a list of items with a sequence of fixed and familiar physical locations), Link Method (e.g., linking items in a list into a series of overlapping images in a chain), and first-letter mnemonics (e.g., car, racket, and bell = CRAB).

2. Suppose the students are asked to do the following tasks, what do you think their responses will be? How do they usually tackle tasks of a similar nature? Please do not ask your students to attempt the tasks in this part of the questionnaire because they will be doing them with the investigator at a later stage.

3. Please put an "X" in the appropriate box. You may wish to use more than one box if the student uses more than one strategy to tackle the tasks.

STUDENT'S USE OF MEMORY STRATEGIES

1. To recall a list of colours in correct serial order:

A. Sample task for student : "You are helping the teacher to tidy up the art room. You are asked to arrange the coloured paper in the following order : red, green, yellow, orange, pink, blue, brown. What do you think would be the best way to remember the correct order of the colours if you cannot write them down?"

B. Student's response : MR ER VI MS

Other strategies (please specify):

2. To recall a list of names:

A. Sample task for student: " You met 10 new friends at a party. Their names are Jody, Justin, Michele, Roy, Mike, Robert, Karen, Kent, Rose, and Jason. What is the best way to remember all of these names so you will be able to call your friends by their names?"

B. Student's response : MR ER VI MS

Other strategies (please specify):

3. To recall main points in a factual story he/she has heard:

A. Sample task for student: " You are going to repeat a story you have heard to your friends. The story has lots of facts in it. While you are listening to the story, what will you do to help yourself remember the story so you can tell your friends?"

B. Student's response : MR ER VI MS

Other strategies (please specify):

4. To recall main points in a descriptive story he/she has heard:

A. Sample task for student: "You are going to repeat a story you have heard to your friends. The story describes lots of things about the life of natives in the north. What will you do to help yourself to remember the main points in the story so you will be able to describe the story to your friends?"

B. Student's response : MR ER VI MS

Other strategies (please specify):

5. To recall main points in a factual story he/ she has read:

A. Sample task for student: " You are given a story to read. The story has lots of facts in it. You have 10 minutes to study the facts before you are asked to make a summary report to class without referring to the book again. How would you prepare for making the summary within the 10 minutes?"

B. Student's response : MR ER VI MS

Other strategies (please specify):

6. To recall main points in a descriptive story he/she has read:

A. Sample task for student: " You are given a story to read. The story describes the scenery and the things that a child has seen on a field trip. Later, you will be asked to describe the story to class without referring to the book. When you are reading, what will you do to help yourself to remember the main points in the story so you will be able to describe the story to the class?"

B. Student's response : MR ER VI MS

Other strategies (please specify):

7. To recall a series of non-meaningful numbers:

A. Sample task for student: " You have to make a long distance phone call with this number : 1-403-456-438. What is the best way to remember this number?"

B. Student's response : MR ER VI MS

Other strategies (please specify):

8. To recall a series of numbers which has to be grouped:

A. Sample task for student: " You are going to meet your friends in a shopping mall. To go there, you will have to take 3 buses. The number of the 3 buses are: 124, 169, 82. What is the best way to remember these numbers in the right order?"

B. Student's response : MR ER VI MS

Other strategies (please specify):

9. To recall items which can be categorized:

A. Sample task for student: " You are on a diet. The doctor gave you a list of food not to eat :

chips, candies, cookies, butter, cheese, liver, red meat, potato, nuts.

What is the best way for you to remember this list so you will remember not to eat them?"

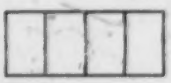
B. Student's response : MR ER VI MS

Other strategies (please specify):

10. To recall items which can be categorized:

A. Sample task for student: " Your mother asked you on the phone to buy fruit, milk, vegetables, eggs, coffee, chicken, ground beef and tea from the supermarket. How would you remember this list so when you get to the store you will be sure to get them all?"

B. Student's response : MR ER VI MS



Other strategies (please specify):

11. To recall verbal instructions:

A. Sample task for student: " You are going to McDonald for lunch with your parents. They ask you to get everything ready in the following order :
(a) Take the coupons from McDonald with you.
(b) Phone your cousin and ask if she would go with you.
(c) Pick up a newspaper on your way.
(d) At McDonald, order 3 hamburgers, 2 milk-shakes, and 2 french fries.

How would you remember all these things so you will be sure to get them all done?"

B. Student's response : MR ER VI MS

Other strategies (please specify):

12. To recall procedures to complete a task in a book he/she has read:

A. Sample task for student: " You have read a recipe for making banana muffin from a cook book. The steps are:
(a) Combine flour, baking powder and salt.
(b) Add egg, oil, sugar and mashed banana.
(c) Fill muffin cups with mixture.
(d) Bake for 25 minutes.

How would you remember all these steps so you will be sure to get them done in the right order?

B. Student's response : MR ER VI MS

Other strategies (please specify):

PART TWO: OTHER INFORMATION ON THE STUDENT

(Please circle the appropriate answers)

1. Describe the ways, if any, you have used to assess the student's strategies to learn and memorize new information :
   A. Use assessment tools. (Please specify assessment tool used)
   B. Observe student's performance:
      (a) in class
      (b) in other occasions e.g., playground
   C. Other (please specify):

2. Does the student check or proofread his/her work without a request to do so?
   A. Yes
   B. No
   C. Sometimes
   D. Other remarks:

3. Does the student look for different or alternate ways to solve problems?
   A. Yes
   B. No
   C. Sometimes
   D. Other remarks:

4. Is the student usually motivated to learn new information in which he/she is interested?
   A. Yes
   B. No
   C. Sometimes
   D. Other remarks:

5. How does the student usually explain the reason for his/her success in accomplishing a task?
   A. His/her efforts
   B. His/her skill and ability
   C. Chance and luck
   D. Other remarks:

6. How does the student usually explain the reasons for his/her failure?
   A. Lack of ability
   B. Lack of skill
   C. Lack of luck
   D. Lack of efforts
   E. Other remarks:

7. Is the student put off by a poor mark on a test/assignment and give up easily?
   A. Yes
   B. No
   C. Sometimes
   D. Other remarks:

8. Does the student have a strong desire to do his/her best in all his/her studies?
   A. Yes
   B. No
   C. Sometimes
   D. Other remarks:

9. Does the student try to do all his/her assignments as soon as they are given to him/her?
   A. Yes
   B. No
   C. Sometimes
   D. Other remarks:

10. Does the student worry that he/she may not be able to do well on a test even when he/she has studied hard for it?
   A. Yes
   B. No
   C. Sometimes
   D. Other remarks:

11. Does the student spend time on learning things that he/she knows won't be asked in the examination?
   A. Yes
   B. No
   C. Sometimes
   D. Other remarks:

12. Can the student be described as a person with self-confidence?
   A. Yes
   B. No
   C. Sometimes
   D. Other remarks:

13. Does the student usually spend adequate time on doing his/her assignment?
   A. Yes
   B. No
   C. Sometimes
   D. Other remarks:

APPENDIX C

INSTRUMENT NO.2
SUBJECT SELF-REPORT ON MEMORY STRATEGY

NAME:
SCHOOL:
GRADE:
DATE:

NOTE:

1. The purpose of the tasks is to find out the subjects' awareness and use of memory strategies when they learn new information.

2. The subjects will be given practices on think-aloud procedures (see Appendix E).

3. The subjects will be not asked to perform the tasks in this instrument. They will be interviewed individually and asked to think-aloud as many strategies as possible if the tasks were assigned to them. Their verbal reports will be tape-recorded for later analysis.

4. Instruction to the subjects:
"The purpose of the tasks is to find out how students learn and memorize new information. You are my co-investigator in this subject. Your answers and contributions in completing these tasks are valuable for designing methods to help other students to learn. Suppose you are asked to do the following tasks (in actual fact, you don't have to do the tasks now). Use the think-aloud method you have just learned and describe to me verbally, in detail, the best method(s) you will use to remember the information. Tell me as many methods as possible to remember these information."

TASKS

1. You are helping the teacher to tidy up the art room. You are asked to arrange the coloured paper in the following order : red, green, yellow, orange, pink, blue, brown. What do you think would be the best way to remember the correct order of the colors if you cannot write them down?

2. You met 10 new friends at a party. Their names are Jody, Justin, Michele, Roy, Mike. Robert, Karen, Kent, Rose, and Jason. What is the best way to remember all these names so you will be able to call your friends by their name?

3. You are going to repeat a story you have heard to your friends. The story has lots of facts in it. While you are listening to the story, what will you do to help yourself to remember the story so you can tell your friends?

4. You are going to repeat a story you have heard to you friends. The story describes the life of natives in the north. What will you do to help yourself to remember the main points in the story so you will be able to describe the story to your friends?

5. If you are given a story to read. The story has lots of facts in it. You have 10 minutes to study it before you are asked to make a summary report to class without referring to the book again. How would you prepare for making the summary within the 10 minutes?

6. You are given a story to read. The story describes the scenery and the things that a child has seen on a field trip. Later you will be asked to describe the story to class without referring to the book. When you are reading, what will you do to help yourself to remember the main points in the story so you will be able to describe the story to class?

7. You have to make a long distance phone call with this number: 1-403-456-438. What is the best way to remember this number?

8. You are going to meet your friends in a shopping mall. To go there, you will have to take 3 buses. The number of the 3 buses are: 124, 169, 82. What is the best way to remember these numbers in the right order?

9. You are on a diet. The doctor gave you a list of food not to eat : "Chips, candies, cookies, butter, cheese, liver, red meat, potato, nuts."

   What is the best way for you to remember this list so you will remember not to eat them?

10. Your mother asked you on the phone to buy fruit, milk, vegetable, eggs, coffee, chicken, ground beef and tea from the supermarket. How would you remember this list so when you get to the store you will be sure to get them all?

11. You are going to McDonald for lunch with your parents. They ask you to get everything ready in the following order :
    A. Take the coupons from McDonald with you.
    B. Phone your cousin and ask if she would go with you.
    C. Pick up a newspaper on your way.
    D. At McDonald, order 3 hamburgers, 2 milk shakes, and 2 french fries.

    How would you remember all these things so you will be sure to get them all done?

12. You have read a recipe for making banana muffin from a cookbook. The steps are:
    A. Combine flour, baking powder and salt.
    B. Add egg, oil, sugar and mashed banana.
    C. Fill muffin cups with mixture.
    D. Bake for 25 minutes.

13. Do you check and proofread your work even when the teacher does not ask you to do so?

14. When you come across problems, do you look for different ways to solve these problems?

15. Do you think you are motivated to learn new information on topics you are interested in?

16. When you are successful in doing a task, how do you usually explain the reason for your success in doing a task? (Effort, ability, skill, chance and luck.)

17. When you fail in doing something, how do you usually explain the reason for your failure? (Lack of ability, skill, luck, effort.)

18. When you get a poor mark on a test/an assignment, do you feel that you want to give up?

19. Do you have a strong desire to do your best in all your studies?

20. Do you usually try to do all your assignments as soon as they are given to you?

21. Do you often worry that you may not be able to do well on a test even when you have studied hard for it?

22. Do you spend time on learning things that you know won't be asked in the examination?

23. Are you a person with self-confidence?

24. Do you usually spend adequate time on doing your work?

APPENDIX D

INSTRUMENT NO. 3
INVESTIGATOR ASSESSMENT ON MEMORY STRATEGIES

NAME OF SUBJECT:
SCHOOL:
GRADE:
DATE:

Note:

1. The purpose of administering the tasks in this instrument is to find out the types of memory strategies (e.g., rehearsal, imagery, mnemonics) the subjects use when learning information.

2. The tasks in this instrument are individually administered to the subjects by the investigator.

3. The subjects are required to perform the tasks and use the think-aloud procedures when recalling or giving the responses. They are allowed to study the material for as long as they want. Cues and prompts will be provided to elicit more detailed responses.

4. The subjects' responses are tape-recorded for later analysis. The presence and incidence of memory strategies will be entered in a rating sheet in Appendix G.

5. A Holiday to Disneyland is the theme of the tasks in this instrument. The purpose of having a theme for the tasks is to maintain the subjects' interest level and to have relevance to the curriculum.

6. General instructions to the subjects:

   "Suppose you are planning a holiday to Disneyland. You want to find out some information about United States and also make some preparation before you go on the trip. I will provide some information to you. You will try your very best to remember these information. There is no time limit for the doing the tasks. You can study the information until you feel you are ready to recall. After I have shown you, or told you the information, I want you to recall what you have heard or seen. While you are recalling, tell me what is in your mind, or how you help yourself to recall.

   I will give you some examples on how to do it." (Give training on think-aloud procedure again. Cues and prompts will be provided to help the subjects to understand how to think-aloud.)

THEME: A HOLIDAY TO DISNEYLAND

Task 1: To recall colours in correct serial order

(A) Topic: Colours of flags

(B) Procedure: The investigator introduces colours of American and Canadian flags by showing the pictures and naming the colours of flags. After studying the colours for some time, the subjects are required to recall the colours of the flags in correct order.

(C) Instruction:

- (a) Disneyland is in the United States of America. Each country has a flag. America has a flag too.
- (b) You live in Alberta in Canada. Canada has a flag. Alberta also has its own flag.
- (c) I am going to show you the flags of America, Canada and Alberta. Try to remember the colours of the flags in exactly the same order as I show you. Also tell me how you help yourself to remember the exact order of the colours.
- (d) " Red, white; red, white, blue; red, white, blue, green, yellow".
- (e) What is the exact order of the colours I told you?
- (f) What did you do to help yourself to remember the exact order of the colours?

Task 2 : To recall first names

(A) Topic: First names of the Presidents in United States

(B) Procedure: Investigator introduces the first names of the Presidents by sounding out the names and showing the pictures. The subject is required to recall the names.

(C) Instruction:

- (a) The leaders of the United States are the presidents. I am going to show you pictures of some of the presidents. I will tell you their first names. Try to remember the names of these presidents and tell me how you help yourself to remember their names.
- (b) " Andrew, Benjamin, Calvin, Harry, James, John, William".
- (c) What are the names of the presidents?
- (d) How did you help yourself to remember these names?

Task 3 : To recall the main points in a factual passage heard

(A) Topic: How did America get its name?

(B) Procedure: Investigator reads a passage about how America got its name. The subject is required to recall the main points he/ she has heard.

(C) Instruction:

(a) Do you know why America is called America? Let me read to you a story about how America got its name. When I am reading, try to remember the main points in the story. After I have finished reading, tell me how America got its name. Also tell me how you help yourself to remember what I have read to you.

(b) "Long time ago, some people found a new piece of land. A king gave some money to a sailor to bring back information about the new piece of land. The name of the sailor was Amerigo. A few years later, a map-maker wanted to put together a new map. He used the information that Amerigo brought back. Since the information of the new piece of land was found by Amerigo, the map-maker called the new piece of land "America".

(c) Why is America called "America"?

(d) When you were listening to the story, how did you help yourself to remember the main points?

Task 4 : To recall a list of daily objects which can be categorized

(A) Topic: A packing list

(B) Procedure: A packing list is presented to the subject. The investigator reads aloud the list. The subject is asked to describe to the investigator what is on the list after the list is removed.

(C) Instruction:

(a) Now we know something about America such as the flag, the presidents, and how it got its name. Now we pretend to plan a holiday to Disneyland in America.

(b) When we go on a holiday, we usually make up a packing list so that we will remember what to bring.

(c) I am going to read to you a short packing list. Try to remember what are on the list because I will ask you to repeat to me the things on the list. Again, you will tell me how you help yourself to remember the things on the list.

(d) "Tooth brush, comb, towel, clothes, socks, money, camera".

(e) What are the things on the packing list?

(f) How did you help yourself to remember these things?

Task 5: To recall a list of food which can be categorized

(A) Topic: Balanced diet

(B) Procedure: Investigator briefly discusses about the importance of a balanced diet while travelling, then presents the pictures of food in the order of health food to junk food. The subject is asked to recall the names of food on the list.

(C) Instruction:
- (a) When we go on a holiday, it is very important for us to have a balanced diet so that we can stay healthy and enjoy our holiday.
- (b) I am going to show you a list of health food that you should eat and junk food that you should avoid. Try to remember what I have shown you and tell me how you help yourself to remember this list.
- (c) "Chicken, beef, pork, potato, carrot, milk, juice" Chips, candy, coke".
- (d) What are the food that I have shown you?
- (e) How did you help yourself remember these food?

Task 6 : To recall a series of non-meaningful numbers

(A) Topic: Make long distance phone call
(B) Procedure: The investigator briefly describes how to make a long distance call. The investigator shows a flash card and verbally presents the phone numbers. The subject is asked to recall the phone number after the flash card is removed.
(C) Instruction:
- (a) You are going to make a long distance phone call to your friend in America to let him/her know that you will visit Disneyland. You have to remember the phone number of your friend. The phone number is (416) 450-492.
- (b) What is the phone number?
- (c) How did you help yourself to remember the phone number?

Task 7 : To recall main points in a descriptive passage he/ she has read

(A) Topic: On a plane
(B) Procedure: The investigator goes over some of the words in the passage. The subject reads the passage. He/she is then given some time to study the passage before he/she is asked to recall the points in the passage.
(C) Instruction :
- (a) Now you are on your way to Disneyland. You will go to Disneyland on an airplane. Read to yourself this passage about what usually happens on the plane.
- (b) Before you begin, let us go over some of the words in the passage: "flight attendant, passenger, oxygen mask, juice, peanut, snack, serve dinner". Now, go ahead and read the passage. While you are reading, try to remember the important points in the passage.

(c) Student reads : "On the plane, the flight attendant showed the passengers how to use the oxygen mask. After a while, the flight attendant gave the passengers juice and some peanuts for a snack. She said, " We will be serving dinner soon".
(d) What are the main points in this passage?
(e) What did you do to help yourself remember the main points in this passage?

Task 8: To recall verbal instruction

(A) Topic: Things to remember on a guided tour
(B) Procedure: The investigator reads the passage to the subject. The subject is then asked to summarize the verbal instruction.
(C) Instruction:
(a) A tour leader will take you to Disneyland. It is important to follow what the tour leader says so that you will not be lost.
(b) Try to remember what the tour leader says. This is what he says to you, " Write down you name, address, and telephone of where you are staying. Bring all the things you need, such as money, camera and a hat. Meet me at 9 o'clock in the morning. Meet me in front of the hotel."
(c) What did the tour leader say?
(d) How did you help yourself to remember what he said?

Task 9: To recall numbers which have to be grouped in the right order

(A) Topic: Go to Disneyland by bus
(B) Procedure: The investigator shows the flash cards and reads the bus numbers. The subject is required to recall the numbers of the buses.
(C) Instruction:
(a) You want to go back to Disneyland again on your own when you have free time. Going to Disneyland from where you are staying, you have to take three buses. Try to remember the numbers of the three buses, otherwise you will go to the wrong place. The number of the first bus is 341, the second bus is 249, and the third bus is 61.
(b) What are the numbers of the three buses?
(c) How did you remember these numbers?

Task 10: To recall main points in a factual passage he/she has read

(A) Topic: Fantasyland in Disneyland

(B) Procedure: The investigator goes over some of the words in the passage. The subject reads the passage. He/she is required to recall the main points in the passage.

(C) Instruction:

(a) Let us find out something about Disneyland. Read this passage about Disneyland. Try to remember what this passage is about. Before you begin reading, let us go over some of the words in the passage: park, United States, tea-cup, race cars, railway station, Mickey Mouse, pictures.

(b) Now read the passage and remember what it says. The subject reads, " Disneyland is a very big park in the United States. One of the areas is called Fantasyland. In Fantasyland, there are tea-cups and race cars for children to ride. There is also a railway station. In front of the railway station is the face of Mickey Mouse. The face of Mickey Mouse is made of red and white flowers. People can take pictures beside Mickey's face."

(c) Tell me the main points in this passage.

(d) What did you do to help yourself to remember all these?

Task 11: To recall procedures he/ she has read for completing a task

(A) Topic: At the entrance of Disneyland

(B) Procedure: The investigator goes over some of the words in the passage with the subject.
After the subject has read the passage, he/she is required to recall the procedures mentioned in the passage.

(C) Instruction:

(a) This passage tells you what will happen at the entrance of Disneyland. Read it carefully and then tell me what will happen there. Before you begin reading, let us go over some of the words: entrance, Disneyland, tickets, coupons, map, Tomorrowland, Fantasyland, decide.

(b) Now read the passage and remember what it says. The subject reads, "At the entrance of Disneyland, you pay for your tickets. You will get coupons for different places in Disneyland. You will get a map of Disneyland. The map will show you where different places such as Tomorrowland and Fantasyland are. You will have to decide which place to go."

(c) What will happen at the entrance of Disneyland? Tell me what this passage is about.

(d) What are the best ways to remember the main points in this passage?

Task 12 : To remember main points in a descriptive passage he/she has heard

(A) Topic: Haunted Mansion

(B) Procedure: The investigator reads a passage about the haunted mansion in Disneyland. The subject is required to recall the main points in the passage.

(C) Instruction:

(a) Inside Disneyland, there are different places. I will describe to you about a place called Haunted Mansion. Listen to what I say and remember the main points. Later on, tell me how you help yourself to remember the main points.

(b) "Disneyland has a haunted house (that is, a ghost house) called the Haunted Mansion. The Haunted Mansion has dark windows. When you enter one of the rooms, a voice will say, "It is too late to turn back." Then the floor begins to sink. At that time, you may want to scream. In another room, you will see ghosts dancing through the tables and chairs. A few minutes later, you will go past an indoor grave yard. Later, you will come to a mirror. If you look in the mirror, you will see a ghost sitting beside you".

(c) Tell me what you can remember about the Haunted Mansion.

(d) What did you do to help yourself to remember all these?

APPENDIX E

PRACTICE IN THINK-ALOUD

Block Design Task

To familiarize the subjects with "thinking aloud", Instrument No. 2 began with an introduction to the block design task in WISC-R. This task was not scored because the purpose was to acquaint the subject with the think-aloud process. The blocks and the design card were shown to the subject, and design one was completed by the investigator. While the investigator performed design one, she demonstrated how she thought aloud. The subject then was told that he/ she was going to do more designs like the example, but that he/she was to tell the investigator everything that he/she was thinking as the design was being constructed. The subject was required to complete all the block design tasks in WISC-R. Cues and prompts were provided to help the subject to understand the think-aloud process.

Each subject was given instructions emphasizing that he/ she was a "co-investigator" who was assisting the investigator in her examination of the strategies used in recalling information. The investigator indicated that thinking aloud might seem silly at first, but that with practice, the subject would get use to it and that it would be fun. In addition, just like a sports broadcaster who provides a play-by-play account of a sporting event, the subject was asked to report each of his/her thoughts as they occurred.

Favorite Sport

To ensure the fact that all subjects understood what was meant by the "think aloud" process, practice in thinking aloud about their favorite sport was instituted before administering Instrument No. 3. Each subject was asked to indicate his or her favorite sport. After specifying the sport, the investigator said, " now pretend you have to tell a six-year-old how to play the game. Tell me everything you think he or she would need to know in order to play the game." When verbalizations about the step in the game were vague, incomplete, or misleading, the investigator probed for further clarification. After successful explaining the steps needed to participate effectively in the game, the investigator said, " I want you to do the same thing again, only this time I want you to think aloud as you are doing the tasks I give you. Remember, tell me everything you are doing and thinking about as you are doing the tasks." The subject was prompted at the outset of each task to think aloud.

APPENDIX F

SCORING CRITERIA AND SAMPLE RESPONSES

The purpose of this Appendix is to clarify and specify the meaning of some of the terms used in this study and to facilitate scoring of responses from the subjects. Sample responses from the subjects are quoted. This Appendix served as a guideline for another rater to score the responses from the subjects, and subsequently an interrater agreement was calculated by using the point by point method.

Memory Strategies

Memory strategies denotes a wide variety of activities performed by the subjects while they are attempting to acquire target information in their working memory. The types of strategies included in this study are maintenance rehearsal, elaborative rehearsal, visual imagery, and mnemonic devices.

Rehearsal Strategies

Rehearsal describes the process of repeating something over and over to oneself. This study adopts Craik and Lockhart's (1972) distinction between two types of rehearsal activities: maintenance and elaborative rehearsal.

Maintenance Rehearsal (MR).

It involves the recycling of items in working memory while the depth of encoding remains unchanged.

Sample response:

- I just repeat it over and over in the same order.
- I repeated it exactly the same way you told me.
- Repeat it over and over in the order I can remember.
- Copy the information word by word.
- Repeat the main points (without changing the depth of encoding).

Elaborative rehearsal (ER).

Elaborative rehearsal relates the to-be-remembered information to other information already known and increases the depth of encoding. Elaborative rehearsal includes strategies for categorizing, grouping, chunking, and using meaningful relationships among to-be-remembered items in order to render them more memorable.

Sample response:

- They all begin with the letter "C".
- These are the things I like/ I hate.
- I use different food groups.
- Associate with things I remember; relate to previous experience/ books read/ what other people told me; think back what I have done before.

- Summarize the information and repeat the information in my head.
- Link the information to something I know.
- Underline the important points and repeat them.
- Group the colours in darker and lighter shades.
- Compare whether the numbers are relatively higher or lower.
- Arrange the names in alphabetical order and repeat the names in alphabetical order.
- This is how I remember the names: I remember Jason. There is a movie about him. Karen's name is like my sister's. And Mike and Michele, they are my cousins. Rose is my sister's friend. Kent reminds me of Superman. Jody is on Today Special.

Visual Imagery (VI)

Visual strategy describes the forming of mental pictures of the to-be-remembered materials to facilitate better memory.

Sample response:

- I put pictures of the story/ colours in my head, then I'll try to remember the pictures.
- I imagine seeing the scene.
- I paint a picture in my head.
- I make up pictures of the objects in my head and keep seeing the pictures.
- I try to link up faces and names in mind.
- I see the things in my mind.

Mnemonic devices (MS)

Mnemonic devices involve embellishing the incoming materials by associating them to previously learned set of peg words or images. Examples of mnemonic techniques include the Peg method, Loci method, the Link method, First-letter mnemonics, and the Keyword method.

Sample Response:

- I remember the first letter of the colours like R (red), G (green) B (blue) ... I would go R, G, B and put the letters to make a word and repeat the word. (First-letter mnemonics -- combine the first letter of the to-be-remembered material into a word that can be repeated).
- I'll remember the first letter of each food. Like G for grapes, B for banana. I then put the letters together to make something like a word, I sound the word over and over.

Other Strategies (OI)

Attention

It includes responses such as listening, paying attention, concentrating and understanding.

Sample Response:

- Listen to it carefully. Don't fool around, follow instruction, no talking to your friends.
- I listen and concentrate on what they are saying.
- Concentrate, understand it.
- I listen, then I repeat "Don't forget it, don't forget it".

Obtain Assistance/ Use of Cues

It describes strategies relying on external cues and assistance to help recall.

Sample Responses:

- Ask someone /a friend / teacher / parent to help or do it for me.
- Write it down; tape it.
- Use something or do something to remind me, e.g., look at where the things should be placed in order to remember what the things are. I look at the things, then I will remember what to buy.
- Ask the teacher again if I forget.
- Tell a friend. Repeat it to a friend.
- I will put the coupons near the phone book so that when I call my cousins, I will see the coupons and remember to bring the coupons.

Do it immediately

The subjects suggested to perform the task immediately so that they would not forget. The awareness of the limitation of short-term memory was implied.

Sample response:

- I do it immediately so that I won't forget.
- I dial the number right away.

Check the results of memorizing

The subjects monitored their memory effort by checking.

Sample response:

- I close my eyes to check if I can remember.
- I give myself a quiz.
- Ask my friend/ parents / teacher to ask me questions.
- I'll tell my friends the story so that I can check if I remember the story correctly.
- After reading the book, I probably say the main points to myself without looking, and then look in the book and see if I am right.

APPENDIX G
SCORING SHEET

Note:

Put a " I/ " in the appropriate box if a memory strategiy is noted in the subject's response.

Strategy	TI	Subject												
		1	2	3	4	5	6	7	8	9	10	11	12	etc.
Maintenance Rehearsal	1													
	2													
	3													
	4													
	5													
	6													
	7													
	8													
	9													
	10													
	11													
	12													
	etc.													
Elaborative Rehearsal, etc.														

TI = Task Items